Appendix B

Site Assessment Plan for the Johnny M Mine and Adjacent Property

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Section 1.0 - Introduction

1.1 Background

The Johnny M Mine development began in 1973, with the first ore produced late in 1976. The last ore production at the Johnny M Mine occurred early in 1982. All ore was shipped off site for milling and recovery of uranium. Uranium mill tailings were brought onto the Johnny M Mine for use as underground structural support material (backfill as part of the mining operation), an activity requiring a Radioactive Materials License (the "License"), which was obtained from the State of New Mexico. Prior to termination of the License, New Mexico relinquished oversight of the License, returning jurisdiction to the Nuclear Regulatory Commission (NRC). License termination occurred in May, 1993, under final reclamation, with the NRC publishing a notice of "final finding of no significant impact", with release for unrestricted use (58 FR 29641, May 21, 1993).

Recent investigations conducted by the U.S. Environmental Protection Agency (EPA) as part of the "Assessment of Health and Environmental Impacts of Uranium Mining and Milling, Five-year Plan Grants Mining District, New Mexico" (EPA, 2010) indicates that mine-related material from the Johnny M Mine may have been disturbed and may have migrated on to adjacent property. The historic Johnny M Mine (hereinafter "Area A") is located on private ground, approximately 5 miles west of the village of San Mateo, New Mexico as shown in Figure 1. The adjacent properties of interest are specifically, the property west of Area A within the western half of Section 18 (hereinafter "Area C"), the property within both the eastern half of Section 18 and the southern half of Section 7 (hereinafter "Area B"), and any drainage pathways to the west of Area C. Areas A, B and C lie within Township 13 North, Range 8 West (T13N, R8W) including areas within Section 18, and the southeast quarter of Section 7. Area A and these adjacent properties will hereafter be referred to jointly as the "project area," as shown in Figure 2. Surface ownership within the project area is all private land.

Sampling of the project area will be used to describe the quantities, characteristics and location of mine-related material in the project area; aid assessment of the extent and transport of mine-related material; and provide an understanding of the means and path of transport of mine-related material from Area A.

For the purposes of this site assessment plan (the plan), "mine-related material" means soil and rock from the historic mining operations that is elevated in uranium decay series radionuclides, including water treatment residuals in the historic mine water treatment area and along the discharge path. Mine-related material does not include background concentrations of naturally occurring radioactive materials or stable elements.

1.2 Objectives

Environmental Restoration Group Inc. (ERG) has prepared this plan to provide the framework and guidance for collecting information regarding the nature and extent of any mine-related material on and around the project area. The objectives of the plan are to:

- Identify the nature, areal extent, and depth of any mine-related material in the project area.
- Provide data to enable an accurate volume estimate of soil impacted by mine-related material.
- Provide background radiological and geomorphological data for nearby native materials for use in interpreting project area sampling data.

Table 1 provides a summary of the proposed plan including types of samples (e.g. gamma surveys, soil), number of samples, general location, sampling method, and type of analysis.

1.3 Setting

San Juan Basin topography is characterized by the combination of two land forms, mesas which dip gently to the north and broad valleys with intermittent streams. Arroyos have incised the mesas by headward erosion forming steep-sided canyons. West of the basin are the San Mateo Mountains and to the south are the Zuni Mountains.

The project area is located on private land situated in the Ambrosia Lake district in sections 7 and 18, Township 13 North, Range 8 West, in McKinley County, New Mexico, approximately one mile north of New Mexico Highway 53. The project area geography is typical of northwestern New Mexico, relatively flat, bordered on three sides by mesas extending to approximately one hundred feet in elevation above Area A. Adjacent land use within one kilometer of the project area is used for livestock grazing. McKinley County is sparsely populated with the small town of San Mateo approximately 4.4 miles to the southwest.

The climate of the project area is classified as semi-arid continental climate. The regional classification is characterized by low precipitation, high evaporation, abundant sunshine, low relative humidity, moderate temperature and infrequent incidences of severe weather. Winter weather patterns are dominated by migratory low pressure storm systems originating over the Pacific Ocean. These winter systems prevail from October through April, with September and May being weather transition months. The summer period of June through August is dominated by a regional thermal low pressure system centered roughly in the Arizona desert, which extends to the surrounding states. Moist air from the southwest can cause the development of thundershowers. The variability of the moisture content of the air influx causes considerable variability in the thundershower intensity and duration. The maximum yearly precipitation occurs during the summer thundershower season. Specifically, during the summer period four to five inches of precipitation is normal, which is approximately 40-50% of the average annual precipitation of approximately ten inches. The average monthly temperature ranges from a low of about 30 degrees Fahrenheit (^{0}F) in January to a high in the in the mid-70s in July. Temperatures can vary from below 0 ^{0}F in the winter to temperatures in excess of 100 ^{0}F in the summer. The normal relative humidity of the area is at its maximum of 65% near sunrise and diminishes to a low of about 30% in mid-afternoon. Gross annual lake evaporation is 50-60 inches per year.

There are no perennial water bodies in the project area or within five kilometers, however there are several unnamed intermittent streams. Two named intermittent streams are both located approximately 2.2 miles to the south (San Mateo Creek) and east (Rafael Canyon Creek). Surface runoff can be expected to occur during periods of intense precipitation, which would most likely be during the summer season. Under average conditions the water runoff can be expected to quickly evaporate and/or percolate into area soils. There are several arroyos that originate with the project area that would collect and channel runoff forming an intermittent stream. These arroyos have been formed by erosion resulting from storm events over many years.

Section 2.0 - Sampling and Analysis Plan

2.1 Ground-based Gamma Surveys

The primary objective of the gamma survey is to determine the aerial extent of potential mine-related material that may be present within the project area. Gamma survey results will also be used as a tool to help identify appropriate background reference areas (BRAs). Gamma survey results are dependent on a variety of conditions including the type of instruments used, the configuration of the instruments (e.g. height above ground surface), soil moisture, and the instrument settings. If the gamma survey results are not related to a common physical parameter, such as exposure rate or concentration of radionuclides in soil, comparison of existing gamma survey data to data collected under different conditions is limited. A GPS-based gamma-ray survey (gamma survey) will be conducted in the project area. The initial gamma survey will be conducted along transects spaced at 50 meters as shown on Figure 3. If additional data are needed to delineate the areal extent of mine-related materials in surface soils or mineralized outcrops, transects will be added or spacing adjustments transect spacing adjustments will be made in the field. Areas where the EPA has performed gamma surveys will be re-surveyed in order to maintain consistent survey conditions across the plan project area.

ERG will employ Ludlum Model 44-10 (or equivalent) 2-inch by 2-inch sodium iodide high energy gamma-radiation detectors, each coupled to a Ludlum Model 2221 ratemeter/scaler that is, in turn, coupled to a Trimble ProXRS GPS unit with a TSCe datalogger, or equivalent. All areas will be surveyed at a speed of approximately 0.6 meter/second, with the detectors held at approximately 0.5 meter above the ground surface. If adjustment of the detector height is required in the field due to high vegetation or other features, appropriate adjustments will be made in the field. Gamma-ray count rates will be recorded every second, with individual count rates tagged with associated New Mexico State Plane location coordinates. Field personnel will drive transects using all-terrain vehicles (ATVs) or walk, carrying the instrumentation in backpacks.

The detection systems will be matched and calibrated to a National Institute of Standards and Technology-traceable cesium-137 check source, and function-checked daily prior to and after the work day.

2.1.1 Area A

A gamma survey of Area A will be conducted as described below. The objective of the gamma survey and grid pattern in Area A is to identify potential mine-related material in Area A and delineate if present.

Area A is located in a canyon with walls that may have naturally occurring rock outcrops with uranium mineralization. The canyon walls and mineralized rock outcrops can increase the detector response within the canyon above normal levels. This phenomenon is predominantly due to scattered gamma radiation off the canyon walls from adjacent areas with elevated gamma radiation and gamma radiation directly from mineralized rock outcrops, if present, and can lead to an overestimation of the source term if not taken into account. To minimize this effect, a static measurement gamma survey will be performed throughout Area A. A 20-meter square grid will be established across Area A as shown in Figure 4. Two static one-minute integrated measurements, one with a downward-looking collimator around the detector and one without, will be made at each grid node. For the measurements made with the collimator, the detector will be placed in contact with the ground. For the measurements made without the collimator the detector will be held approximately 0.5 meter above the ground surface. The static measurement gamma survey is in addition to the 50 meter transect survey described in Section 2.1 above. The same model of detectors will be used for both the GPS-based gamma survey and the static measurement gamma survey.

Mineralized rock outcrops, and downgradient sediment erosion of these outcrops, are naturally occurring and don't represent mine-related material but are considered part of the background condition of the area. A walking gamma scan of the canyon walls and mesa tops in and around Area A will be performed in areas that can safely be accessed to identify mineralized outcrops. The location of outcrops, if found, will be surveyed using GPS equipment and mapped.

2.1.2 Area B

As shown on Figure 2, Area B is within both Section 7 and the eastern half of Section 18, minus the footprint of Area A. The objective of the gamma survey within Area B is twofold:

1) To delineate the areal extent of any mine-related material.
2) To provide a tool to help identify appropriate BRAs for other project areas that may contain mine-related material.

The gamma survey will be conducted as described in Section 2.1. Two areas likely to be representative of background are shown on Figure 2 and Figure 3 and described as "Probable Background Areas". BRAs will be proposed in areas where mine-related material is not evident based on the gamma survey data, topography, historical reports, and visual inspection. The proposed BRAs will also have similar geomorphology as areas that may contain mine-related material. The location of the proposed BRAs will also be presented to the regulatory oversight agency.

2.1.3 Area C

As shown on Figure 2, Area C is within the western half of Section 18. The objective of the gamma survey within Area C is twofold:

1) To delineate the areal extent of any mine-related material, including the area following the path of historic discharge.
2) To provide a tool to help identify appropriate BRAs for other project areas that may contain mine-related material.

The survey will include an area that extends off Area C to the west, along the arroyo, if gamma survey results indicate mine-related material occurs in this area.

Area C has been the focus of recent radiological investigations conducted by the EPA. Gamma survey results are dependent on a variety of conditions including the type of instruments used, the configuration of the instruments (e.g. height above ground surface), soil moisture, and the instrument settings. If the gamma survey results are not related to a common physical parameter, such as exposure rate or concentration of radionuclides in soil, comparison of existing gamma survey data to data collected under different conditions is limited. Therefore, Area C will be surveyed again as described in Section 2.1 in order to maintain consistency in gamma survey results across the project area.

2.2 Exposure Rate Measurements

Direct exposure rate measurements will be made using a Reuter Stokes Model RSS-131 High Pressurized Ion Chamber (HPIC) or an equivalent detector.

The HPIC responds to ionizing radiation by collecting all charges created by direct ionization within the detector gas through the application of an electric field. The HPIC measures energy deposited by gamma-rays, x-rays, and cosmic radiation without discrimination. It is highly stable, relatively energy independent, and serves as an excellent tool to calibrate (in the field) other survey equipment to measure exposure rates.

The HPIC data will be correlated to gamma-radiation count rates collected using the same geometry and detection systems used in the gamma survey as described in Section 2.1. The number and location of the HPIC correlation measurements will be based on the range of exposure rates as determined from the gamma survey data. Using this correlation, the count-rate data from the gamma surveys will be converted to exposure rates. As part of the plan, a project area--wide map of the predicted exposure rates will be produced showing exposure rates. This map will be invaluable at the time of mitigation since it is independent of the type of gamma-ray detector that will be used to guide mitigation.

2.3 Soil Sampling and Analysis

The objectives of the soil sampling component of this work plan are threefold:

1) To determine the depth of potential mine-related material, samples of surface soil (0-15 cm depth) and sub-surface soil (>15 cm depth) will be collected and sent to an off-site National Environmental Laboratory Accreditation Program-certified laboratory for analysis to determine the concentrations of radionuclides (natural uranium, radium-226, and thorium-230) and metals (arsenic, barium, lead, molybdenum, selenium, and vanadium) potentially indicative of mine-related materials. Henceforth, these radionuclides and metals are referred to as "indicator radionuclides" and "metals." The results will be evaluated to determine the vertical extent of any mine-related material within the project area. This information, coupled with information regarding the areal extent of any mine-related material, will be used to estimate volumes of material that may be subject to mitigation activities.
2) Surface and sub-surface soil concentrations in Areas A through C, along with gamma measurements, will be used to develop an understanding of any mine-related material that may be necessary for evaluating potential erosion of this material.
3) Samples of surface and sub-surface soil will be collected in potential BRAs and tested to determine the concentrations and variability of indicator radionuclides and metals that are representative of the natural background condition of the project area. This information is necessary to interpret the data and will be used to evaluate the volume of mine-related material that may be subject to future mitigation activities.

In addition to collecting soil samples, down-hole gamma measurements will be made at each sample location using radiation detection equipment similar to that described in Section 2.1. The average gamma radiation response of these locations will be considered the background response for down-hole gamma measurements and used for comparison to down-hole measurements in other project area soil sample locations to help delineate the vertical extent of any mine-related material.

2.3.1 Area A

The focus of the soil sampling in Area A will be the mine spoil pile and the location of two historic mine water retention ponds.

A minimum of twelve soil cores extending through the mine-related material will be collected at locations shown on Figure 5 using a direct push hydraulic probe or hollow stem auger with split spoon sampler. The locations shown on Figure 5 are proposed and may be moved to alternative locations that better meet the objectives as stated in Section 2.3 above, if necessary. Each core will be logged for depth and gamma radiation using collimated gamma radiation detection equipment similar to that described in Section 2.1. Alternatively, if the direct push hydraulic probe is unable to collect representative samples of material, a backhoe may be used to excavate a trench through any mine-related material and gamma surveys of the sidewalls of the trench performed. Samples will be collected from each of the locations, at the following depth intervals: 0 to 15 cm, 15 cm below ground surface (bgs) to the bottom of radiological contamination, and an additional 15 cm below the bottom of radiological contamination. The bottom interval (an additional 15 cm below the bottom of radiological contamination) is intended to verify that the depth of any mine-related material that has been identified. In cases where the first depth interval indicates that the depth of any mining-related material has been fully penetrated, the second depth interval will not be collected. The samples will be analyzed for the indicator radionuclides and metals.

If naturally occurring outcrops of uranium mineralization above Area A are encountered, representative samples of the mineralized material will be collected and sent for laboratory analysis for the indicator radionuclides and metals.

2.3.2 Area B

Mine-related material contains radionuclides and metals that are also naturally ubiquitous in soil. The degree to which these radionuclides and metals are present in soil varies by area but in all cases the natural concentration of radionuclides and metals in soil is considered the background condition of the area. Any proposed mitigation of mine-related material has to consider the background conditions of the area as part of the mitigation.

It is not expected that significant amounts of mine-related material are located in Area B. However, erosion pathways downgradient of Area A are present within Area B, along with a portion of the historic pathway of the treated mine water discharge. To account for these features, soil samples will be collected at a minimum of five locations in Area B, as depicted in Figure 5. The samples will be collected at 0 to 15 cm, 15 cm to the bottom of radiological contamination, and an additional 15 cm below the bottom of radiological contamination. The bottom interval (an additional 15 cm below the bottom of radiological contamination) is intended to verify that the depth of any mine-related material that has been identified. In cases where the first depth interval indicates that the depth of any mining-related material has been fully penetrated, the second depth interval will not be collected. If mine-related material in Area B is encountered –as indicated by the gamma survey- additional soil samples may be collected as needed to determine the nature and depth of the material. Furthermore, portions of Area B are outside areas expected to be impacted by mine-related materials and are not downgradient of potential erosion pathways, thus provide areas for BRA evaluation. Portions of Area B exhibit similar geomorphological features (e.g. gently sloping areas down gradient of mesas potentially containing mineralized rock outcrops with uranium) to that of Areas A and C.

Two areas likely to be representative of background for the project area are shown on Figures 2 and 3. It is likely the BRAs will be established somewhere within these two general areas. If gamma survey results or geomorphological features indicate that these areas do not represent background, alternative areas will be selected. The location of the proposed BRAs will also be presented to the regulatory oversight

agency. Once the final locations of the BRAs have been established, approximately 15 soil sampling locations will be randomly placed within each of these areas. Soil samples will be collected at depths of 0-15 cm and 15-45 cm at each location using a hand auger or trowel. All Area B soil samples will be sent for laboratory analysis of indicator radionuclides and metals.

2.3.3 Area C

Soil samples extending through any mine-related material will be collected at a minimum of 19 locations, including erosion pathways downgradient of Area A and along the historic pathway of the treated mine water discharge. Figure 5 provides proposed locations based on EPA's gamma survey data. Actual locations will be dependent on the results of the gamma surveys discussed in Section 2.1.3. Soil samples will be collected at three depths at each location using a hand auger or hand trowel. Two of the three soil depth intervals will be determined in the field, based on down-hole measurement responses. The first two depth intervals are intended to represent the surface (0-15 cm) and depth (15 cm to the bottom of radiological contamination) of any mine-related material. The bottom interval (an additional 15 cm below the bottom of radiological contamination) is intended to verify that the depth of any mine-related material that has been identified. In cases where the first depth interval indicates that the depth of any mining-related material has been fully penetrated, the second depth interval will not be collected.

If metals analyses indicate that the depth of mine-related material in the historic discharge path has not been delineated and soil concentrations pose an unacceptable risk, a resistivity geophysical survey may be considered.

2.4 Geomorphologic Survey

2.4.1 Objective

The objective of the proposed geomorphologic survey is to characterize the existing terrain features and geomorphological stability of Area A to evaluate active and potential erosion processes as well as existing and potential pathways for erosion of mine-related material. The geomorphological information will also be used when evaluating future mitigation to stabilize mine-related material in place if needed. In addition, a geomorphologic survey in Area C will be necessary to determine potential disposal cell locations.

2.4.2 Aerial Photography Review

Existing aerial photographs and satellite imagery will be reviewed to identify, if possible, changes in drainage courses, sedimentation patterns, and vegetation from earliest available imagery to the most recent. This review will support assessment of rates and patterns of erosion that should be considered in selection and design of mitigation measures, if needed.

2.4.3 Ground Survey

A walking survey over approximately 40 acres of Area A, in addition to appropriate portions of Area C, will be performed to ground truth and update the information obtained from the aerial photography review. Photographs and measurements will be taken of rock falls and slides (if any), drainage courses, rills and vegetation patterns to evaluate relative erosion rates, sediment source and deposition locations, and surface water catchments. This information will be synthesized into a map that identifies relative geomorphic stability of surfaces within the survey area. This information will be used in selection of potential disposal cell locations in Area C, and for the evaluation of other potential mitigation measures including regrading, riprap placement, and revegetation.

2.5 Geotechnical Sampling

2.5.1 Objectives

The objectives of the geotechnical sampling of soil and rock are to determine:

1. The location and characteristics of suitable soil for use as liner and/ or cover material during mitigation, if needed.
2. The location and characteristics of suitable erosion control material (rip-rap).
3. The volumes of suitable materials present.

2.5.2 Sample Selection and Analysis

In conjunction with the soil sampling performed for radiological characterization (Section 2.3 above), geotechnical soil sampling will be performed. A qualified geologist, geotechnical engineer, or senior soil technician will be present to perform field classification of soil and to package and label the geotechnical samples. A minimum of 10 classification samples will be obtained. To the extent possible, splits of the radiological soil samples will be separately packaged for ASTM-standard geotechnical testing including:

- Grain size analysis
- Soil moisture
- Plasticity

Where sufficient quantity of soil is not separable from the radiological samples, another sample at the same location and depth will be obtained.

The geotechnical representative will also obtain bulk samples (five gallons) of soil that could be considered for construction borrow material. These bulk samples will be tested for classification, as above, and also for compaction density (Standard Proctor ASTM D-698).

2.6 Site Stabilization

As an interim site stabilization measure to mitigate the potential for any off-site sediment transport, a filter fabric silt fence will be installed as a temporary sediment barrier. The silt fence will be constructed near the western boundary of Area C traversing the un-named arroyo that bisects the site. The best location for silt fence installation will be determined in the field. An estimated 300-500 feet of fence will be installed.

The silt fence will be removed upon final reclamation of the site.

Section 3.0 - Quality Assurance

This section generally describes items important to data quality for the proposed work. The requirements in this section meet the intent of the EPA's quality assurance (QA) guidance contained in *Guidance for Quality Assurance Project Plans (QA/G-5)* (EPA, 1998) and *Requirements for Quality Assurance Project Plans (QA/R-5)*, EPA, 2001a.

A Quality Assurance Plan (QAP) is provided as Appendix A. The QAP provides guidance to ERG management and staff who are responsible for continuously improving and implementing the QA program for quality-affecting project work. The QAP meets the intent of the EPA's guidance for Quality Management Plans contained in *Requirements for Quality Management Plans (QA/R-2)* (EPA, 2001b).

3.1 Data Objectives

Data quality objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of the data to be collected. The data objectives in this document are intended to ensure the collection of data in the project area to:

1. Effectively assess the areal and vertical extent of any mine-related material in the project area.
2. Establish the background radiation condition that is representative of the project area.
3. Provide information to enabled selection of effective mitigation for the project area.

3.2 Sample Analysis and Quality Objectives

Table 2 provides the laboratory DQOs and analytical methods for selected soil parameters associated with soil sampling program. Also included in Table 2 are the geotechnical parameters and methods for soils.

3.3 Personnel Qualifications

All project technical field personnel will meet or exceed the minimum requirements for their assignments through formal education, experience, and project-specific training, in accordance with SOP 4.10. All technical field personnel will have the necessary training in the specific data collection, surveying, sampling, sample handling, and site-specific safety procedures required for their respective assignments on this project. A field manager will be in charge of directing the sampling and survey efforts.

3.4 Field Procedures and Instruction

Standard procedures and instructions will apply to quality-impacting activities, materials, and equipment. In general, procedures will follow ERG standard operating procedures (SOPs) and ASTM International (ASTM) standards. ERG SOPs are provided in Appendix B.

The applicable SOPs and ASTM standards include:

SOP 1.01	Calibration of Scaler, Ratemeter
SOP 1.04	High Energy Gamma Scintillation Calibration and Checkout
SOP 1.13	PIC Setup and Operation
SOP 1.30	Function Check of Equipment
SOP 2.08	Monitoring for Ra-226 in Surface Soils Using a Gamma Scintillation Detector
SOP 2.09	Gamma-Radiation Correlation Studies
SOP 2.15	Sample Control and Documentation
SOP 2.22	Surface and Shallow Subsurface Soil Sampling
SOP 4.10	Technical Quality Control
SOP 4.12	Soil Data Validation
SOP 5.11	Setup and Operation of Trimble ProXRS GPS Receiver with Trimble TSCe Datalogger
SOP 5.12	Download, Correction, and Export of GPS Survey Data
SOP 5.13	Performing GPS Radiological Survey by Vehicle
ASTM D4288	Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D5730-04	Standard Guide for Site Characterization for Environmental Purposes

3.5 Sample Documentation, Handling and Custody Requirements

3.5.1 Field Documentation

Two forms of field documentation will be maintained:

1. Field data sheets
2. Field logbook

Field Data Sheets

A three-ring binder or folder that holds field data sheets that includes but is not limited to instrumentation check sheets, instrument calibration sheets, and soil sampling sheets will be maintained during the sampling activities. This binder will contain the paperwork necessary to complete a single day of surveying or sampling. One sheet will be completed for each soil sample collected for laboratory analysis. Any deviations from standard protocols or notable events (e.g., rainy weather, etc.) should be entered in the section for "Notes". The field manager will sign the form when sampling is complete and all data are entered onto the forms.

Field Logbook

Information contained in this log includes the following:

- Survey/Sample date
- Survey/Sample personnel
- Weather Conditions
- Time survey/ sampling begun each day
- Time sampling concluded each day
- Description of daily activities
- Description of deviation from SOPs

- Signature of data recorder

This logbook will be maintained daily during investigative activities.

3.5.2 Sample Handling, Chain of Custody, and Sample Shipment

A chain-of-custody form shall accompany every shipment of samples to the analytical laboratory. The purpose of the chain-of-custody form is to establish the documentation necessary to trace possession from the time of collection to final disposal, and to identify the type of analysis requested. All corrections to the chain-of-custody record will be initialed and dated by the person making the corrections. Each chain-of custody form will include signatures of the appropriate individuals indicated on the form. The originals will accompany the samples to the laboratory, and copies documenting each custody change will be recorded and kept on file.

When shipping samples to the analytical laboratory, the shipping forms or transmittal memo will describe:

- Sample identifiers
- Number of containers
- Sample preservative
- Date and time of sample shipments

All required paper work, including sample container labels, chain-of-custody forms, custody seals and shipping forms will be fully completed in ink (or printed from a computer) prior to shipping of the samples to the laboratory.

Upon receipt by the laboratory, chain-of-custody forms will be reviewed for completeness, and samples will be logged and assigned a unique laboratory sample number. Any discrepancies or abnormalities in samples will be noted and the project manager will be promptly notified.

3.5.3 Sample Naming

The sample identifier is to be coded in the format XXX-NN-xx-LLLL-MMDDYYYY, where:

- XXX-NN is the sample location,
- xx is the sample media type, since this SAP addresses sampling of soil only, the media type is always S.
- LLLL is the soil depth interval with the first two positions representing the top of the sample interval and the last two representing the bottom of the interval. (0015 would represent the depth interval of 0-15 cm).
- MMDDYYYY is the date of sampling.

The first part of the sample location identification number indicates the type of location, as follows:

- AA = Area A
- AB = Area B
- AC = Area C
- BRA= background reference area

The second part of sample location identification number is 01, 02, etc.

The depth intervals (LLLL) are unknown until field work begins. If more positions are need due to increasing depth, they can be added to provide the same number of spaces that are given to the top of the interval and bottom of the interval. For example, a depth interval of 0 to 100 centimeters would be 000100.

The date of sampling is in the format two digit month, two digit calendar date, and four digit year.

The location numbers greater than 15 are reserved for dummy names for the field duplicate QC samples to be submitted blind to the laboratory unless otherwise documented in the field sampling logbook.

The following demonstrate the use of the sample identifiers:

- AA-06-S-1545-10142011 indicates a soil sample with a depth interval from 15 to 45 cm from Area A collected on October 14, 2011
- BRA-01-S-0015-10152011 indicates a soil sample representing the depth interval of 0-15 cm collected at the background reference area on October 15, 2011

3.5.4 Record Keeping

Chain-of-custody forms will be maintained until final disposition of the samples by the laboratory and acceptance of analytical results by ERG. One copy of the chain-of-custody will be kept by field personnel and will be included with the report.

Following completion of the project, ERG will consolidate and maintain all original log books, field data sheets, analytical data packages and reports, and any other information required to document and support the findings of the sampling activities until otherwise directed by Hecla.

3.5.5 Quality Control Requirements

The principal objectives of any sampling and analysis program are to obtain accurate and representative environmental samples and to provide valid analytical data. The quality of data will be assessed through the use of QC samples analyzed on a regular basis. Laboratory QC samples will be analyzed pursuant to analytical method protocols to evaluate whether laboratory procedures and analyses have been completed properly. For this project, the types of QC samples to be analyzed are defined and their role in the production of QC data are discussed in the following sections, and summarized. The accuracy and measurement requirements for each QC sample are discussed in the following sections and summarized. In addition to the particular QC requirements identified in the subsequent sections, all analyses must be performed within holding times and must adhere to all procedures as outlined in the appropriate SOPs.

3.5.5.1 Field Quality Control Samples

Field QC samples are samples that have been either collected or prepared in the field that are submitted in a blind fashion to the laboratory. The only type of field QC sample that will be collected is the Field Split/Replicate sample.

Field Split/Replicate: Field split/replicate samples are two aliquots of the same sample; split samples are prepared after the original sample has been homogenized, and replicate samples are collected sufficiently close in space and time that the samples should be identical. These samples are submitted blind to the laboratory to measure the precision of laboratory analysis. Field splits/replicates will be

collected at a frequency of 5 percent of all soil samples collected (1 field split per 20 investigative samples). Initially, the acceptance criteria for field splits/replicates will be a relative percent difference (RPD) that does not exceed 40 percent or, alternatively, in the case of radiometric data with associate error reported, a replicate error ratio (RER) of 2. In cases where the RPD or RER exceed the acceptance criteria, a more detailed evaluation of the data, including results from laboratory control samples discussed below will be conducted to determine the usability and qualification of the data.

3.5.5.2 Laboratory Quality Control Samples

Laboratory QC samples are samples that are prepared at the laboratory and are analyzed along with field samples to monitor the accuracy and precision of analysis. The types of Laboratory QC samples that will be collected during the soil sampling program are summarized below:

Matrix Spike: A matrix spike (MS) sample is an investigative sample having a matrix that is representative of all investigative samples to which a known concentration of target analytes is added. This quality control sample measures the extent that the sample matrix affects the accuracy of reported target analytes and is proposed to be performed at a frequency of 5 percent of all investigative samples prepared for analysis (1 matrix spike for every 20 investigative samples, for each media) or 1 per preparation batch, whichever is more frequent. Two matrix spike samples are typically prepared, with the duplicate (MSD) also run so that the RPD or RER of the two can be evaluated. Historical records of both the recovery of the spike amounts and the RPDs of the target analytes are maintained by the laboratory to determine acceptance criteria. Where possible, samples should be submitted in batches so that a project sample will be used for the MS/MSD; alternatively, arrangements can be made with the laboratory to insure that a project sample is used.

Laboratory Control Sample (LCS): A LCS originates in the laboratory or is provided as a standard reference material (SRM) by a manufacturer (e.g. NIST) and contains target analytes of known concentration. Because LCSs are independent of the calibration standards, they are analyzed to verify the accuracy of the standards used to calibrate the instrument. A LCS is proposed to be performed at a frequency of 5 percent of all investigative samples) or 1 per preparation batch, whichever is more frequent. The LCS must fall within manufacturer's certified acceptance limits. Two LCS samples are typically prepared, with the duplicate (LCSD) also run so that the RPD or RER of the two can be evaluated.

Laboratory Duplicates: Laboratory duplicates are splits that are prepared by the contract laboratory. Because the laboratory is aware that the samples are duplicates, these samples serve to test the precision of the laboratory's sample preparation and analysis. A laboratory duplicate is proposed to be performed at a frequency of 5 percent of all investigative samples prepared for analysis (1 laboratory duplicate for every 20 investigative samples) or 1 per preparation batch, whichever is more frequent. Initially, the acceptance criteria for laboratory duplicates will be a RPD that does not exceed 40 percent or, alternatively, the absolute difference should not exceed 1 x RL (whichever is less stringent). The RER should not exceed 2.

Instrument Blanks: An instrument blank is composed of the reagents, solvents, or matrix of investigative sample following sample preparation and is used to discern if laboratory-induced contaminants may suggest that laboratory-induced contamination may have occurred. Corrective actions must take place prior to analysis of investigative samples.

3.6 Instrument/Equipment Testing, Inspection and Maintenance Requirements

3.6.1 Field Equipment

Field equipment planned for use during the sampling program will be inspected daily to ensure it remains in good working condition. All information relating to the daily instrument/equipment inspection, calibration and maintenance will be documented on appropriate forms or in the field logbook.

3.6.2 Laboratory Equipment

Laboratory equipment planned for chemical analysis during this investigation will be inspected daily to ensure it remains in good working condition. Any maintenance that is performed on the instruments must be documented in the respective instrument maintenance logbooks maintained at the laboratory.

3.7 Instrument Calibration and Frequency

3.7.1 Field Instruments

Instrument calibration of field radiation detection equipment will be performed prior to initiation of the work and will be recalibrated annually if required. Calibration checks will be performed each day, prior to and following the use of the instrument in accord with procedures outlined in the respective SOPs.

3.7.2 Laboratory Instruments

All laboratory instruments used in the analysis of samples generated during this project will be calibrated by the laboratory in accord with the requirements of the instrument manufacturer and the requirements specified in the relevant analytical method or ASTM standard. Calibrations must be acceptable before any measurements on investigative samples may be made. Traceable calibration standards will be obtained by the analytical laboratories. All documentation relating to receipt, preparation and use of standards will be recorded in the appropriate laboratory logbooks. This information will become part of the raw analytical data package, if requested.

3.8 Data Management

All data will be entered into a project-specific database by appropriately trained staff. The data entered into the database will include all relevant field information regarding each sample collected, as well as the analytical results provided by the laboratory. All data entries will be reviewed and validated for accuracy by the project manager or his/her delegate. All original data records (both hard copy and electronic) will be cataloged and stored in their original form until otherwise directed by Hecla.

3.9 Data Validation and Usability

The following sections describe the requirements and methods for data review, validation, and verification. In addition, the process for reconciling the data generated with the requirements of the data user is also defined.

3.9.1 Data Review, Verification, and Validation

The process of data review, validation, and verification is intended to provide consistent and defensible analytical results. Analytical data generated as part of this project will be reviewed and verified before they are incorporated into the project database.

Corrective actions will be taken as necessary, including contacting field personnel and laboratory as warranted. If major or persistent problems with laboratory analytical data are identified, laboratory corrective actions beyond contacting the laboratory may include requesting full analytical data packages. Interpretation of full data packages may require third party data validation to independently verify laboratory instrument calibrations, accuracy with respect to calibration standards, laboratory duplicates, MS/MSD and LCS/LCSD spike recoveries and RPDs.

3.9.1.1 Data Verification

Data verification will include a review of the findings of all assessments of field collection procedures, sample labeling methods, chain-of-custody procedures, and all assessments of analytical data collection, recording and reporting. If any deviations are identified, the potential impact of those deviations on the reliability of the data will be assessed.

3.9.1.2 Data Validation

The data validation process consists of evaluation of all individual samples collected and analyzed to determine if results are within acceptable limits. These quantitative or qualitative limits of acceptability are defined for Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC), as discussed below.

Precision: Precision is defined as the agreement between a set of replicate measurements without assumption or knowledge of the true value. Agreement is expressed as either the relative percent difference (RPD) or replicate error ratio (RER) for duplicate measurements. Data on precision are obtained by analyzing duplicate or replicate measurements.

Accuracy: Accuracy is a measure of the closeness of a sample analysis result to the "true" value. The accuracy of an analytical method is generally assessed by inserting a series of blind "performance evaluation" (PE) samples into the laboratory sample stream, where the "true" concentration of analyte in each PE sample is known. For this project, accuracy will be evaluated using LCS data reported by the laboratory

Representativeness: Representativeness is the degree to which data accurately and precisely represent characteristics of a population, parameter variations at a sampling point, or an environmental condition. For this work plan, representativeness is ensured by the selection of sampling locations in accordance with the sampling design requirements presented above.

Comparability: Data are comparable if collection techniques, measurement procedures, methods, and reporting units are equivalent for the samples within a sample set. These criteria allow comparison of data from different sources. Comparable data will be obtained by specifying standard units for physical measurements and standard procedures for sample collection, processing, and analysis. These requirements are specific in SOPs for sample analysis procedures.

Completeness: Data are considered complete when a prescribed percentage of the total intended measurements and samples are obtained. Analytical completeness is defined as the percentage of valid analytical results requested. For this sampling program, collection of samples at a minimum of 60 percent of the planned locations must be obtained to achieve a satisfactory level of data completeness.

Validation/verification will be completed on all analytical results for samples tested. This will be performed to ensure that data were produced in accord with procedures outlined in this project plan. The following elements will be reviewed for compliance as part of the validation/verification:

- Methodology
- Holding Times
- Calibration (field instruments)
- Blanks
- Spikes
- Duplicates
- Reporting Limits
- MS/MSD and LCS/LCSD (laboratory to be contacted if MS/MSDs are frequently out of acceptance criteria)

Section 4.0 - Health and Safety Plan

The site-specific health and safety plan (HASP) to support the site assessment work is provided in Appendix C. This HASP is consistent with guidance contained in *Standard Operating Safety Guides* (EPA, 1992).

Section 5.0 - Schedule

Field work will be implemented in accordance with the schedule set forth in the Settlement Agreement and Administrative Order on Consent.

Section 6.0 - References

EPA, 1992. *Standard Operating Safety Guides, 9285.1-03, PB92-963414,* June 1992.

EPA, 1998. *Guidance for Quality Assurance Project Plans* (QA/G-5), EPA/600/R-98/018, February 1998.

EPA, 2001a. *Requirements for Quality Assurance Project Plans (QA/R-5)*, EPA/240/B-01/003, March 2001.

EPA, 2001b. *Requirements for Quality Management Plans, EPA (QA/R-2).* EPA/240/B-01/002, March, 2001.

EPA, 2010. *Assessment of Health and Environmental Impacts of Uranium Mining and Milling, Five-year Plan Grants Mining District, New Mexico.* United States Environmental Protection Agency, Region 6 EPA, GSF-TR. August, 2010.

Tables

Table 1. Summary of Scope

Survey Method/Endpoint	Baseline Investigation Scope	Parameters Evaluated
A. GPS-based gamma surveys	18- inch high, unshielded gamma-ray readings coupled with x- and y- coordinates taken every second moving along 50 meter transects at ≤1 meters per second. Surveys will be made over the entire project area.	Gamma count rates serve as basis to estimate exposure rates, radium-226 concentrations in surface soil and identify the areal extent of any mine-related material and to provide information regarding an appropriate background reference area.
B. GPS-based gamma surveys at fixed points in Area A.	One minute integrated gamma reading collected with an unshielded detector at a height of approximately 0.5 meter and on soil contact with a collimated (shielded) detector. All measurements will be coupled with x- and y- coordinates taken at the nodes of a 20-meter square grid system.	Shielded gamma count rates serve as basis to evaluate areal extent of any mine-related material in areas where scattered radiation (shine) may be significant.
C. Soil sampling of Area C	Up to 57 samples at 19 locations collected at the following depth intervals: 0 to 15 cm, 15 cm surface to the bottom of radiological contamination, and an additional 15 cm below the bottom of radiological contamination.	Indicator radionuclides and metals for all samples. Data will be used to establish depth of any mine-related material.
D. Down-hole Gamma Measurement	Down-hole gamma screening of soil sampling locations. Gamma count rate data will be collected at approximately 15 cm intervals at each soil sampling location.	Gamma count rates will be compared to background response determined from background reference area evaluation. This information will be used to establish depth of any mine-related material.
E. Soil Sampling of Area A	Samples will be collected at a minimum of twelve locations at the following depth intervals: 0 to 15 cm, 15 cm surface to the bottom of radiological contamination, and an additional 15 cm below the bottom of radiological contamination.	Indicator radionuclides and metals for all samples. Data will be used to characterize nature of any mine-related material.
F. Soil sampling of Area B, including random sampling of each potential BRA.	Samples at a minimum of five locations outside BRAs collected at the following depth intervals: 0 to 15 cm, 15 cm surface to the bottom of radiological contamination, and an additional 15 cm below the bottom of radiological contamination. Up to thirty soil samples from 15 locations in each BRA collected at depths of 0-15 cm and 15-45 cm.	Indicator radionuclides and metals for all samples. Data will be used to establish background condition of project area.

Table 2. Soil Sample Analytical and Geotechnical Method and QC Requirements

Parameter	Method	Detection Limit	Minimum Sample Size	Preservation Method	Comments
Digestion	EPA Method 3052	Not applicable	0.5-1 g	None	This is a total sample digestion using hydrofluoric acid.
Natural Uranium	EPA Method 6020A	0.01 mg/kg	500 g	None	
Isotopic Thorium	ASTM 3972-2	0.2 pCi/g	500 g	None	
Radium-226[a]	EPA 901.1 M	0.2 pCi/g	500 g	None	
Arsenic, Barium, Lead, Molybdenum, Selenium, Vanadium	EPA Method 6020A	0.2 mg/kg	500 g	None	
Particle Size Distribution and Atterberg Limits	ASTM D421, D422, D4318	Not applicable	500 g	None	Assumes sample mass of 500 g is adequate for evaluation of all geotechnical parameters.
Particle Size for Fine-grained Soil Fractions	ASTM C117	Not applicable	-	None	
Soil Moisture Content	ASTM D2216	Not applicable	-	None	
Laboratory Compaction	ASTM D698	Not applicable	-	None	

a. Laboratory will report all identifiable naturally occurring gamma-emitting radionuclides.
pCi = picocurie
g = gram
mg = milligram
kg = kilogram

Figures

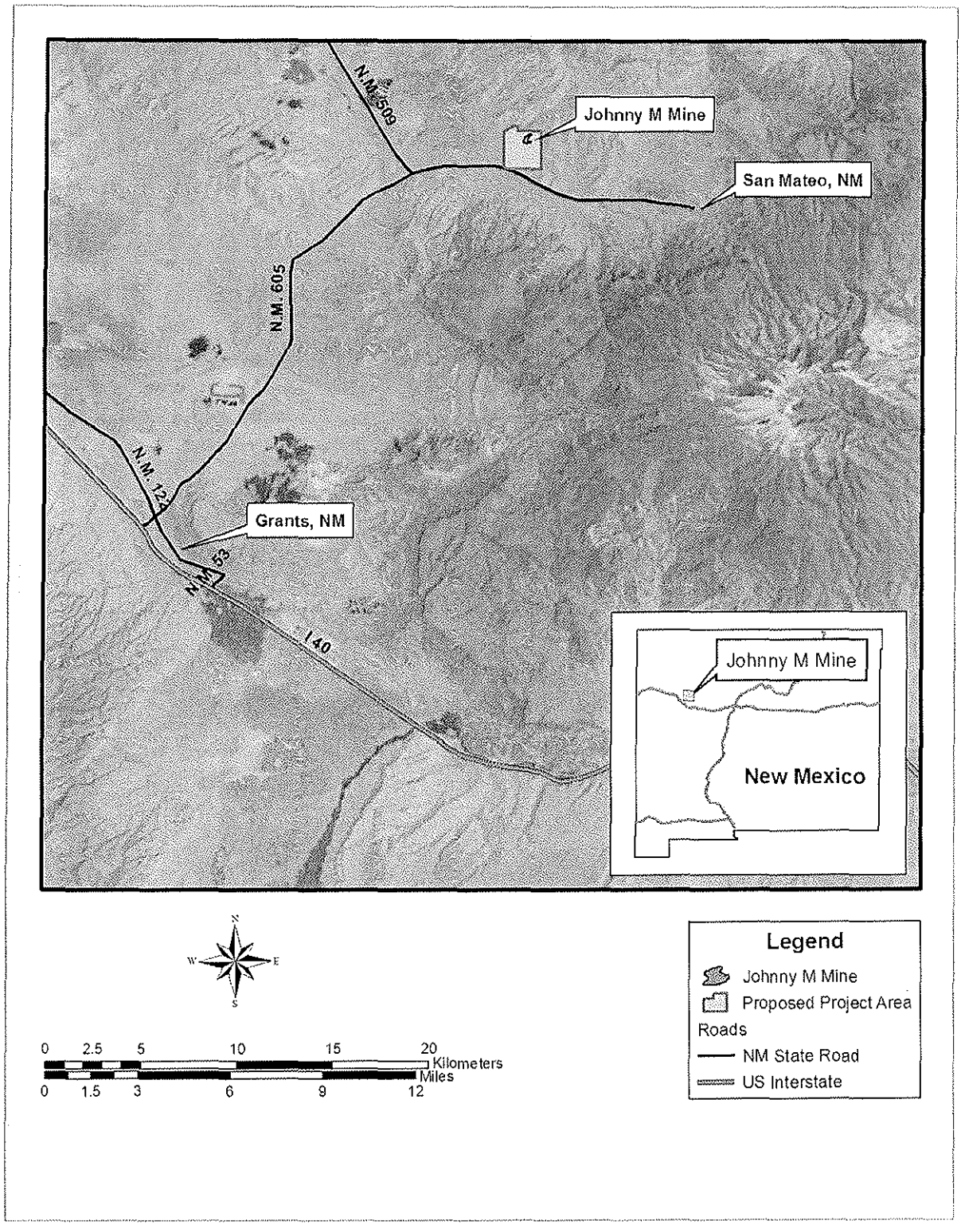

Figure 1. Location of Johnny M Mine and proposed project area.

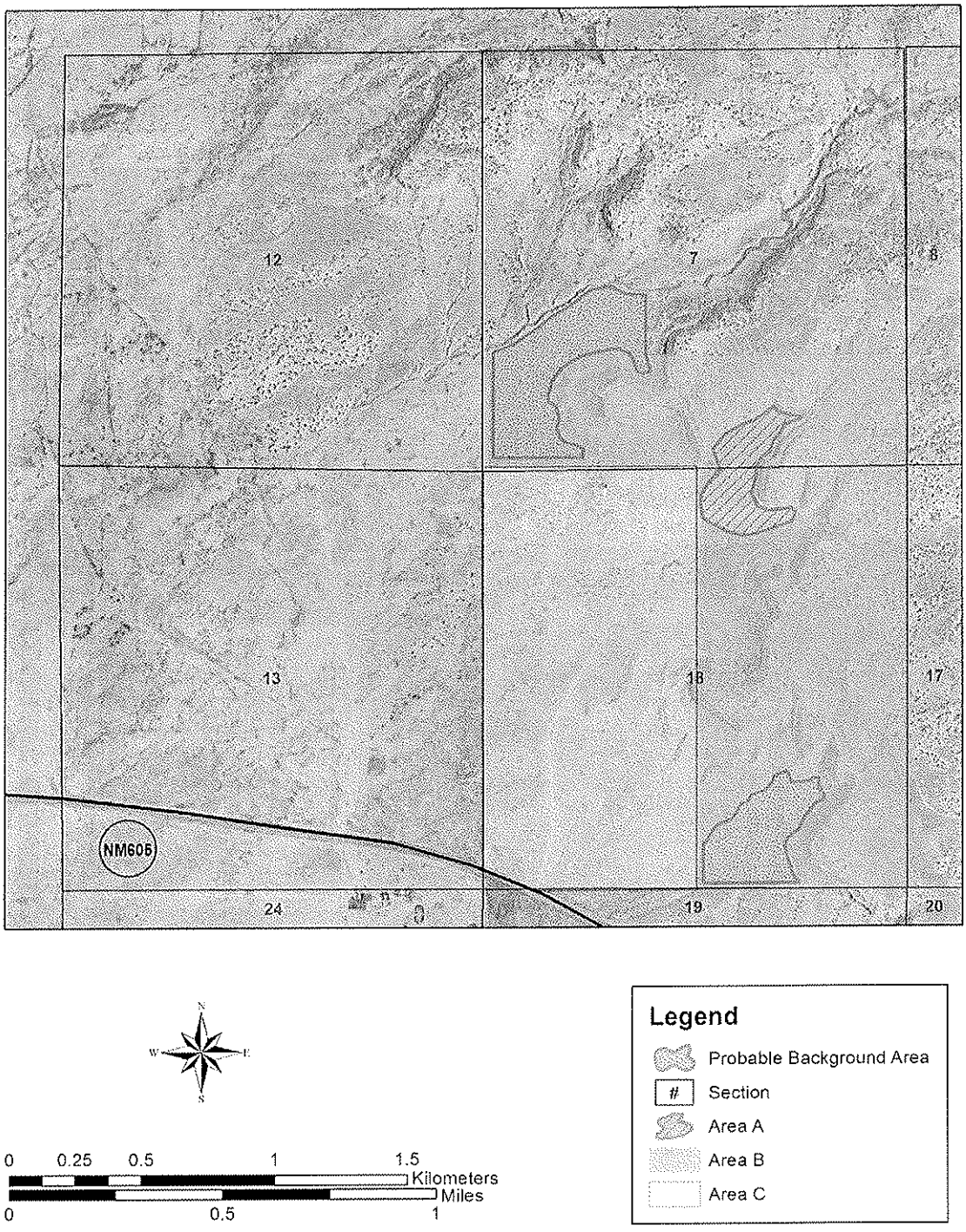

Figure 2. Lay-out of the proposed project area.

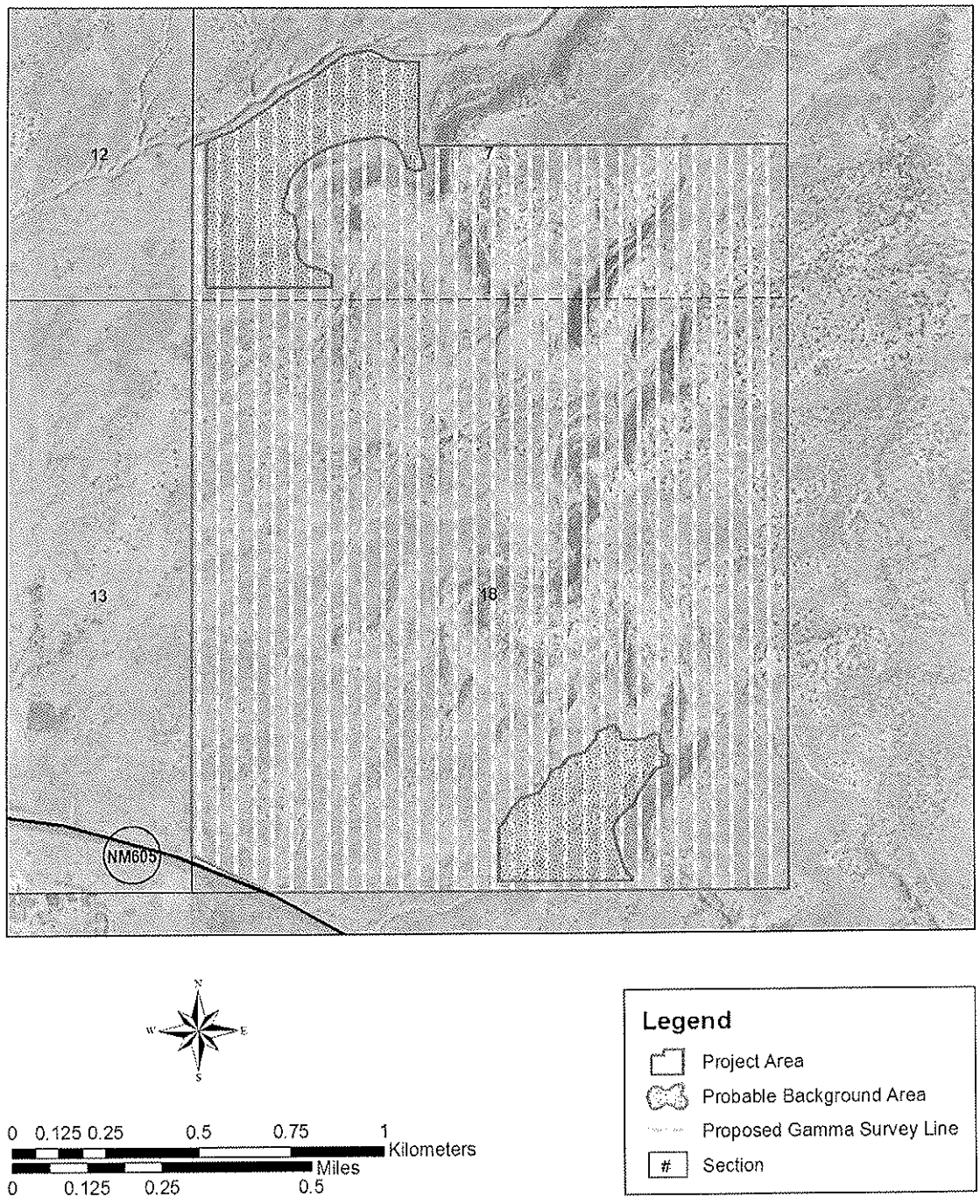

Figure 3. Proposed gamma survey area with 50 meter transects.

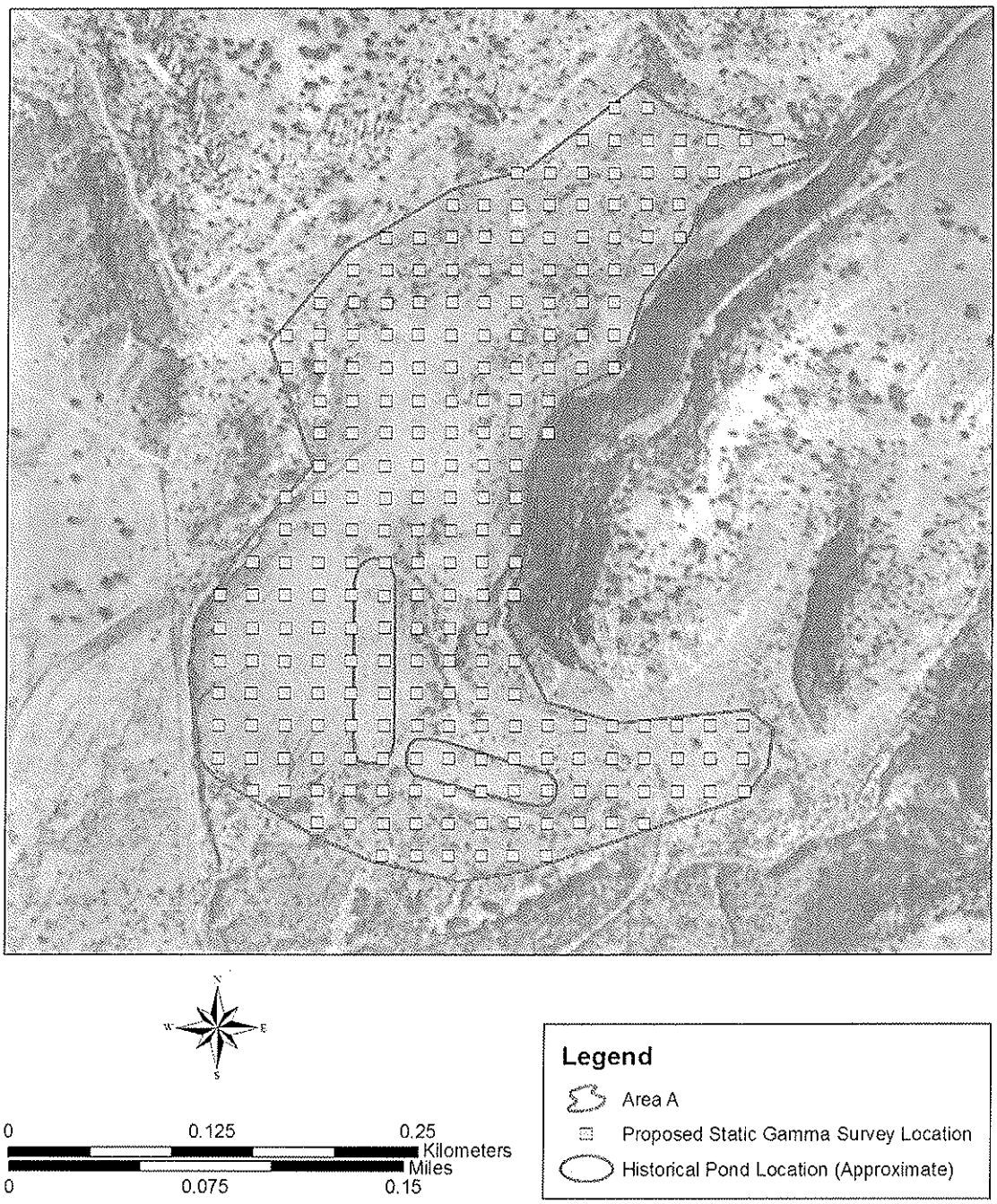

Figure 4. **Proposed static gamma survey locations (20-meter square grid nodes) in Area A.**

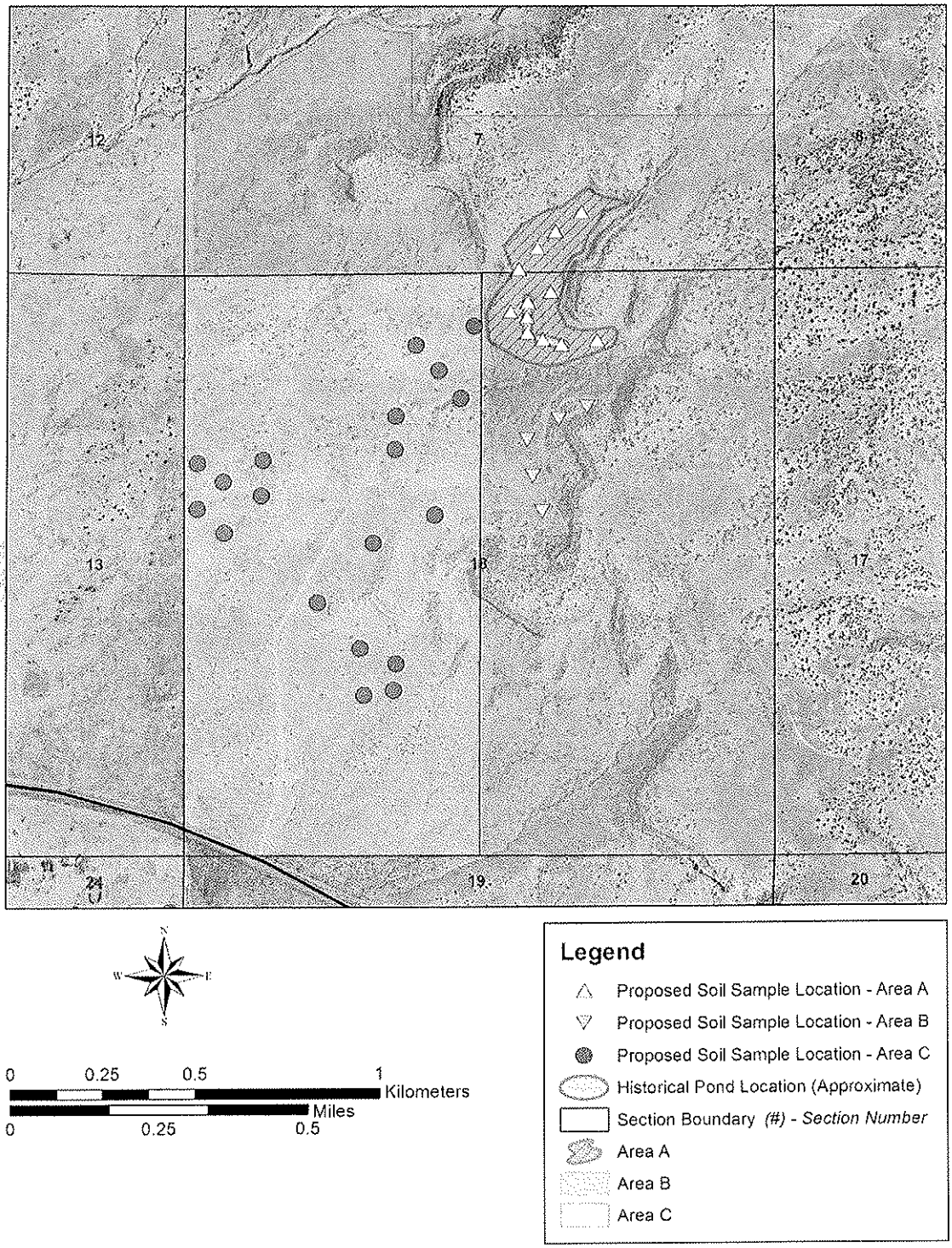

Figure 5. Proposed soil sample locations for the project area.

Appendix A

Quality Assurance Plan

QUALITY ASSURANCE PLAN

for

Environmental Restoration Group, Inc.

Revision No.	Revised Pages, Sections, Etc.	Approval Signature	Title	Date

Controlled Copy Number

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TABLE OF CONTENTS

INTRODUCTION

Environmental Restoration Group, Inc. (ERG) is a small business engaged in providing environmental services. ERG is primarily involved in site characterization work, preparing planning documents, and supporting the remediation of radiologically contaminated sites. ERG does not do design work.

This document provides guidance to ERG management and staff who are responsible for continuously improving and implementing the QA program for quality-affecting project work. This program is written to comply with the requirements of Part 10 Code of Federal Regulations (CFR) Subpart 830.120, *Quality Assurance* (the Rule). Each section of this plan is introduced by its corresponding Rule criterion, followed by the applicable requirements and references to the implementing ERG Standard Operating Procedures (SOP). ERG Series 4 Standard Operating Procedures were written to support this plan and are included in Attachment 1. A listing of all other ERG Technical Standard Operating Procedures is provided in Attachment 2.

Because of our small size, most of our work is done as a subcontractor to larger contractors. In those cases, the contract will most likely have quality requirements in addition to this plan.

SECTION 1: PROGRAM

A written Quality Assurance Program (QAP) shall be developed, implemented, and maintained. The QAP shall describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work. The QAP shall describe management processes, including planning, scheduling, and other resource considerations.

1.1 PLANNING FOR QUALITY

Quality can be achieved through a systematic approach to work that includes four successive elements: plan, do, check, and act. The expectation of continuous quality improvement is an integral part of this approach. Planning is a key element and is performed to provide a clear definition of how programmatic and operational responsibilities and requirements will be achieved.

The actual degree of applicability or rigor applied to requirement compliance (the graded approach) is a management determination detailed in specific activity planning documents. The extent to which QA requirements are applied to specific activities depends on an activity's level

of impact on quality. The following factors, at a minimum, are used to determine the extent to which an activity affects quality:

- Health and safety of personnel
- Health and safety of the public
- Protection of the environment
- Consequence of item or process failure
- Importance of data
- Complexity of function
- Reliability of function
- Reproducibility of results
- Uniqueness of product
- Degree of item or process standardization
- Necessity of special controls or processes
- Significance to statutory regulatory requirements

1.2 ORGANIZATIONAL STRUCTURE

The ERG organizational structure is appropriate for a small company with a few employees where it may be necessary for a person to serve in more than one capacity. The authorities, responsibilities, and duties of the personnel performing activities affecting quality are described below.

1.3 ORGANIZATION RESPONSIBILITIES

The organization responsibilities for quality-affecting project activities are clearly established in this plan, in procedures, and in detailed work instructions designed to obtain the following results:

- That project management establishes and directs a program to achieve, maintain, and improve quality in meeting performance objectives.
- That operations are conducted and quality is achieved, maintained, and improved by those assigned responsibility for performing work, including those checks, tests and inspections, management assessments, and other evaluation techniques used to give personal and management confidence in results.
- That achievement, maintenance, and improvement of quality are independently verified by personnel not responsible for performing the work.

1.3.1 Operations Manager

The Operations Manager has overall responsibility for development and oversight of the project QA program and for approving this plan. The Operations Manager shall resolve differences of opinion between project QA personnel and other project organization. The operations manager provides leadership and allocates appropriate resources for implementing the QA program, including the following responsibilities:

- Establishes and defines overall goals, objectives, and policies.
- Directs and oversees the implementation of the QA program.
- Provides leadership in strategic planning and approves planning documents.
- Fosters an atmosphere conducive to continuous improvement of quality.
- Establishes and participates in internal reviews and accommodates external assessments of the effectiveness of the QA program.
- Obtains and maintains all required QA documentation for the project.

1.3.2 QA Manager

The QA Manager is functionally independent of any group or individual directly responsible for the activities that he monitors. He has the authority and organizational freedom to enforce QA requirements; identify quality problems; and initiate, recommend, or provide solutions to QA problems. He also verifies the implementation of the solutions and assures that further processing, delivery, installation or use is controlled until proper disposition of any non-conformance, deficiency, or unsatisfactory condition has occurred. The QA Manager is responsible for auditing, inspecting, and testing project operations as required. The QA Manager also has the following responsibilities:

- Verify that participating suppliers have approved QA programs and procedures, as required.
- Approve QA program plans of participating suppliers.
- Assure that project design documents contain applicable QA requirements.
- Approve quality-affecting procurement documents, instructions, procedures, and drawings for inclusion of quality requirements.
- Assure that further processing, delivery, installation, or use of non-conforming items is controlled until proper disposition has occurred.
- Perform audits to verify that QA requirements are being met.

1.3.3 Project Manager

Project Managers directing project work should be accountable for the quality of their products and activities. Specific responsibilities with respect to quality include:

- Define organizational and activity-specific work, goals, objectives, schedules, milestones, etc.
- Determine activities for which planning documents need to be prepared.
- Submit for operations manager approval planning documents prepared for activities in their areas of responsibility.
- Ensure that conditions identified as adverse to quality are corrected promptly.
- Conduct management assessments and promote self-evaluation of work activities within their areas of responsibility to ensure that QA requirements are being effectively implemented.
- Ensure that resources to meet quality commitments and needs are available.
- Promote quality principles and attitudes.

1.3.5 Project Staff

Staff members performing project activities that affect quality are responsible for planning, achieving, assuring, and improving quality in the performance of their work. This includes appropriate qualification, training, and proficiency; ensuring that requirements for their assigned tasks are documented and complied with, and ensuring that quality deficiencies and opportunities for improvement are promptly reported and addressed. Staff members are accountable to the Project Manager in the performance of the following duties:

- Actively participate in work planning and readiness preparations as required.
- Execute work activities consistent with the requirements of the applicable plans and procedures.
- Perform work to ensure that required actions are carried out to achieve quality objectives.
- Identify potential conditions adverse to quality and stop work if the condition could become a hazard to workers, the public, or the environment.
- Identify opportunities for quality improvement.

1.4 QA PROGRAM MANAGEMENT AND INTEGRATION

General requirements and responsibilities specific to the project QA program are broadly described herein. Greater detail is provided in procedures. All project subcontractors, vendors, consultants, or others performing or contributing to project activities shall be required to abide by the provisions of this plan or to equivalent QA programs of their companies, which have been approved by the QA Manager. The Project Manager has overall responsibility for project quality and regulatory compliance. Management, at all levels, has direct responsibility for quality achievement (i.e., accomplishing project goals), quality assurance (formal planning of, controlling, and verifying activities), quality management (managing activities consistent with quality philosophy and quality principles), and quality improvement (continuously striving for betterment) within their areas of responsibility.

1.4.1 Quality Assurance Policies, Goals, and Objectives

It is the policy of ERG that all activities governed by the Code of Federal Regulations, licenses, contracts, or other regulatory requirements, shall be conducted in accordance with written approved procedures that incorporate the regulatory requirements. Quality related activities shall be performed with specified equipment under suitable environmental conditions and prerequisites shall be satisfied prior to inspection, operation, or testing. Adherence to the procedure requirements is mandatory for all ERG employees.

It is ERG's goal and objective to provide a reliable QA Program for all activities that affect quality or public health and safety, or are specified by a regulatory or contractual requirement. This goal and objective is achieved through the use of written procedures, management memoranda, and management/staff meetings designed to evaluate the effectiveness of this program.

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1.4.2 Implementing Procedures

Implementation of this plan is accomplished through approved written procedures. In general, the applicable ERG procedures will be used to perform project work and are referenced herein where appropriate. The QA Manager is responsible for developing and approving any project-specific procedures for activities that may not be adequately covered by existing ERG procedures.

1.5 DELEGATION OF MANAGEMENT AUTHORITY

Management at any level may delegate assigned QA program tasks as appropriate and warranted; however, whenever possible, the operations manager and other line management should actively participate in the QA program. Delegation of task performance should not abrogate personal management responsibility for the achievement of quality.

1.6 STOP WORK RESPONSIBILITY AND AUTHORITY

All project personnel shall be responsible for stopping any and all work they determine to be a hazard to the health and safety of workers or the public or to cause environmental damage. Project personnel also shall be responsible for identifying and reporting practices or conditions that are or may be unsatisfactory as they relate to the QA requirements. Managers shall have the responsibility of assessing unsatisfactory or potentially unsatisfactory practices or conditions and taking appropriate action, including stopping work. In all cases, these responsibilities shall override planning and scheduling considerations.

SECTION 2: PERSONNEL TRAINING AND QUALIFICATION

Personnel shall be trained and qualified to ensure they are capable of performing their assigned work. Personnel shall be provided continuing training to ensure that job proficiency is maintained.

2.1 POSITION REQUIREMENTS AND SELECTION

The minimum educational, experience, and other initial qualification requirements for positions involved in the performance of project quality-affecting activities shall be established commensurate with the job functions associated with those activities. Project-specific qualification requirements shall be established for ERG personnel and, when appropriate, for subcontractors or consultants.

2.2 ORIENTATION AND TRAINING

Personnel performing activities affecting quality are trained and indoctrinated as to the purpose, scope, and proper implementation of the QA program, the specific QA requirements, and the project procedures to assure proficiency for the tasks that they are to perform. The proficiency of personnel performing project activities affecting quality is maintained through a program of on-the-job training when applicable and indoctrination meetings as required. The QA Manager is responsible for the training of individuals performing these functions if required.

Before beginning quality-affecting activities, and subsequently thereafter as significant QA program changes occur, personnel shall receive an orientation on the project QA program. This orientation shall include a general introduction to the purpose, scope, implementation, and applicability of the QA program.

Appropriate general and project-specific environment, safety, and health (ES&H) training shall be provided to all personnel. Project-specific training shall include instruction in the procedural or administrative requirements of planning, performing, documenting, and checking assigned activities. Training assignments should be based on a supervisory analysis of individual personnel needs.

Training may consist of formal classroom sessions, reading assignments, hands-on workshops, and other applicable training methods or combinations of methods, as appropriate to the situation and the individual trainee. Training shall be upgraded when requirements are revised or other improvements are identified.

2.3 PERSONNEL CERTIFICATION

Personnel responsible for performance, inspection, and control of special processes and operations that require special skills and have an effect upon quality shall be certified. Personnel for these processes or operations shall be trained and qualified in accordance with the codes and/or standards applicable to the process. Inspection results and quality audits shall be used as indicators of the need for additional training. A record of the names of certified personnel, their skills, and certification periods shall be maintained.

2.4 PROFICIENCY EVALUATION

Immediate supervisors shall continuously monitor (maintain awareness of) personnel proficiency in understanding their job requirements, competently performing their assigned quality-affecting tasks, and progressively improving their capabilities. Formal evaluation of proficiency should be documented as part of the usual performance appraisal process. If an individual's level of proficiency is unsatisfactory, project supervisors should, in addition to standard personnel actions, suspend the applicable job task, counsel the individual, and assign appropriate training or professional development.

2.5 IMPLEMENTING PROCEDURES

ERG SOP 4.01 Training, Indoctrination, and Certifying Personnel

SECTION 3: QUALITY IMPROVEMENT

Processes to detect and prevent quality problems shall be established and implemented. Items, services, and processes that do not meet established requirements shall be identified, controlled, and corrected according to the importance of the problem and the work affected. Correction shall include identifying the causes of problems and working to prevent recurrence. Item characteristics, process implementation, and other quality-related information shall be reviewed and data analyzed to identify items, services, and processes needing improvement.

3.1 PROBLEM PREVENTION, CORRECTION, AND CONTINUOUS IMPROVEMENT

The principal objective of a QA program is to establish, implement, and continuously improve quality requirements that help ensure high performance and ES&H risks and impacts are minimized through effective management. This is achieved by implementing management controls and continually seeking out and acting upon improvement ideas. Project processes shall be developed and implemented that ensure the prompt identification, disposition, tracking, trending, cause analysis, and lessons learned of project quality problems and improvement opportunities.

3.1.1 Nonconforming Items or Services

If items or services are found to be in non-conformance with specifications or subcontract requirements, the following actions shall be taken:

- For items, the inspector attaches a reject tag to the non-conforming item and segregates it from accepted items where practical.
- For services, the manager identifying the non-conformance requests that the QA Manager formally notify the contractor and request corrective action.

The QA Manager or his designee shall issue a non-conformance report for either case. The report indicates the reason for the non-conformance and recommended corrective action, if any, and provides follow up verification of the corrective action.

3.1.2 Subcontractor Control

Subcontractors shall promptly notify the ERG Project Manager and QA Manager of all deviations from the procurement requirements, such as deviations from the required codes or approved drawings. The subcontractor, in accordance with the subcontractor's QA program, shall cease further fabrication or operations on the affected item or service until the

nonconformance has been resolved. The subcontractor shall supply records of nonconformance report disposition of "accept as is" or "repair." These reports shall be made part of the contract records and forwarded to the ERG QA Manager for review and assessment.

3.1.3 Verification of Rework or Repair Acceptability

Acceptability of services rework or item rework or repair of materials, parts, components, systems, or structures shall be verified by review, inspection, and/or testing the service or item to the original criteria, or by a method which is at least equal to the original inspection and testing method. Review, inspection, testing, rework, and repair records shall be documented and filed in ERG project quality records files.

3.1.4 Nonconformance Disposition

The individuals or groups identified on non-conformance reports shall have the responsibility and authority for disposition of non-conforming items. Project QA is responsible for reviewing, approving and verifying the disposition of non-conformances.

3.1.5 Assessment of Non-conformances

Non-conformance reports shall be analyzed periodically by Project QA to show quality trends and the results reported to the Project Manager for review.

3.2 CORRECTIVE ACTION

Conditions adverse to quality (i.e., non-conformances, failures, malfunctions, deficiencies, deviations, defective materials, etc.) shall be evaluated to determine the need for corrective action in accordance with established procedures. Corrective action shall be promptly initiated when it is determined that an existing non-conformity in a material, a process, or a product is due to an assignable cause and is repetitive in nature.

The corrective action process shall include:

- Investigation of the discrepancy,
- Determination of root cause,
- Identification of corrective action to be taken,
- Tracking of corrective action implementation, and
- Evaluation of the corrective action results.

The appropriate person within the project organization shall be assigned the responsibility for a corrective action. Corrective action includes, but is not limited to, procurement or manufacturing operations, design, construction, and operation. The results of a corrective action shall be documented. Project QA shall review applicable records to verify proper implementation of corrective actions. Effectiveness of corrective actions shall be continuously monitored as a function of quality surveillance. Significant conditions adverse to quality, the root cause of such conditions, and the corrective action taken shall be reported to Project Manager for review.

When corrective action requests affect a project vendor, the vendor shall be required to provide the following information:

- A description of factors contributing to the deficiency,
- A description of corrective actions taken to prevent recurrence of the discrepancy in future production.

3.3 IMPLEMENTING PROCEDURES

ERG SOP 4.02 Nonconformance and Corrective Actions

SECTION 4: DOCUMENTS AND RECORDS

Documents shall be prepared, reviewed, approved, issued, used, and revised to prescribe processes, specify requirements, or establish design. Records shall be specified, prepared, reviewed, approved, and maintained.

4.1 DOCUMENT CONTROL

Documents that specify project QA program requirements or prescribe quality-affecting activities shall define document control measures to assure adequate review, approval, release, and distribution of original documents and subsequent revisions. These documents may include but are not limited to design specifications, drawings, procurement documents, and special process, test, operating procedures, and instructions. The persons, groups, and/or organizations responsible for reviewing and approving documents and their revisions for that project shall be identified in the implementing procedure.

4.1.1 Document Changes

Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval. Approved changes are included in the applicable drawings, procedures, instructions, or other documents prior to the implementation of the change.

4.1.2 Document Availability

The latest revision of documents shall be available at the location where activities affecting quality are performed prior to commencing the work.

4.1.3 Vendor Documents

Document control for vendors shall be handled as follows;

- Subcontractors and vendors shall maintain an effective drawing control system when drawings are provided for the project as part of the contract requirements.
- Procurement of articles to project design requires a document control system that includes assurance of notification of changes to the subcontractor or vendor, verification of change incorporation, and appropriate identification of those items on which the change is incorporated.
- Procurement of articles of subcontractor's design requires a document control system that assures subcontractor notification of the project of the proposed change, approval of the change by the project, and appropriate notification of the items on which the change is incorporated.

4.1.4 Procurement Documents

Procurement documents shall assure that applicable regulatory requirements, design basis, and other requirements necessary for adequate quality assurance are included in documents for procurement of items or services. These requirements include the following:

- Scope of Work – The scope of work at all tiers of supply level are adequately defined.
- Technical Requirements – Technical requirements for the items or services to be furnished include or reference the appropriate specifications, codes, standards, and regulations. Test, inspection, and acceptance requirements are identified.
- Right of Access – At each tier of procurement, the procurement documents provide for the right of access to the supplier's plant for inspection. The procurement documents specify events to be witnessed, schedule the hold and witness points, identify minimum advance notice of tests, and means of communication regarding these tests.
- Special Quality Assurance Requirements – Special quality assurance requirements are specified.
- Documentation Requirements – Procurement documents specify the documentation required and establish a submittal schedule.

Project QA shall examine procurement documents to assure the following:

- All applicable requirements of this plan and applicable regulations (i.e., 10 CFR 830.120, NQA-1, 40 CFR Part 260 Series, and/or 10 CFR 71, Subpart H) are addressed.
- The design basis technical requirements including material and component identification requirements, drawings, specifications, codes and industrial standards, tests and inspection requirements, and special process instructions, and inspection, witness, and hold points, as applicable, are addressed.

4.2 RECORDS MANAGEMENT SYSTEM

Documents that support or provide objective evidence of the planning, direction, and accomplishment of project quality-affecting activities should be designated as quality records.

Project processes shall assure that documents designated as quality records are uniquely identified, formally accepted and validated, indexed, classified, received, stored, preserved, and dispositioned.

4.2.1 Quality Records

Project procedures shall specify the collection, storage, and retention of QA records associated with the design, procurement, manufacture, delivery, and start-up of quality-affecting systems, components, operations, and services. The quality records process shall be established and implemented to assure that sufficient written records are maintained to furnish evidence of activities affecting quality. These records include but are not limited to design records, records of use, and the results of reviews, in-process assembly and final inspections, packaging and shipping inspections, tests, audits, monitoring of work performance, materials analyses, waste characterization, and related records such as qualifications of personnel, equipment, and procedures for special processes.

Procurement technical specifications shall identify those records to be transmitted to the project for retention by the project and those to be retained by the supplier. The records shall be identified, indexed, and stored in accessible locations. Maintenance of project records shall be in accordance with written approved procedures that address duration of storage, responsibilities for safekeeping, preservation, and disposition of non-permanent records. Maintenance of records at participating organizations is in accordance with their approved program.

4.2.2 Responsibilities

The responsibility for obtaining and maintaining all required QA documentation for the project rests with the Project Manager. The QA Manager establishes guidelines defining the scope of the required QA documentation, as amplified or modified by contract requirements.

4.2.3 Lifetime Records

Lifetime records shall include, as a minimum: design specifications, stress reports or stress calculations, "as built" and interface control drawings, copies of material test reports, tabulation of materials for "as built" configuration, nondestructive examination reports, including examination results and disposition reports, and copies of waste characterization data reports.

4.2.4 Non-permanent Records

All non-permanent records required to verify compliance with the applicable codes and the vendor's or subcontractor's Quality Assurance Program shall be maintained until project completion, unless otherwise stipulated.

4.2.5 Record Storage Facilities

Record storage facilities shall be constructed, located and/or secured to prevent destruction of records by fire, flood, theft, and deterioration. As an alternative, duplicate sets of documentation may be maintained in separate locations.

4.3 IMPLEMENTING PROCEDURES

ERG SOP 4.03 Project and QA Records

SECTION 5: WORK PROCESSES

Work shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means. Items shall be identified and controlled to ensure their proper use. Items shall be maintained to prevent their damage, loss, or deterioration. Equipment used for process monitoring or data collection shall be calibrated and maintained.

5.1 PROCEDURES AND INSTRUCTIONS

Procedures and instructions shall be prepared, reviewed, approved, and revised for project quality-affecting activities to the level of detail required to ensure that activities can be performed and documented by qualified personnel without direct supervision. Procedures, instructions, and/or drawings provide the method for compliance with the applicable nationally recognized codes, standards, specifications, and/or project-specific requirements. Project activities affecting quality shall be performed and documented in accordance with these procedures and instructions. When applicable, procedures and instructions should include or refer to appropriate qualitative or quantitative performance objectives and acceptance criteria for determining that prescribed activities have been completed as specified. Procedures and instructions shall be uniquely identified, retrievable, reproducible, and have a standardized format.

5.1.1 Quality Assurance Review

The QA Manager, or designee, shall review and approve project procedures, instructions, and drawings to verify inclusion of appropriate quality requirements.

5.1.2 Special Procedures

All special fabrication, installation, and inspection processes that have an effect on the quality of the component, system, or fabrication operations shall be controlled by process procedures. Special process procedures shall be reviewed and approved by the QA Manager to ensure their

adequacy. Process procedures shall include the method, qualification requirements, equipment, and associated control parameters.

5.1.3 Test Procedures

Testing shall be performed in accordance with written and approved procedures, prepared by the cognizant manager and reviewed by the QA Manager, in accordance with standards, procedures, or instructions that include the following quality assurance requirements, as applicable:

- Requirements and acceptance limits as contained in the applicable design documents.
- Detailed instructions for performing the test.
- Calibrated instrumentation.
- Adequate and appropriate equipment.
- Trained, qualified, and as appropriate, licensed and/or certified personnel.
- Preparation, condition, and completeness of the item to be tested.
- Suitable and, if required, controlled environmental conditions.
- Mandatory inspection hold points for witness by responsible individual.
- Acceptance and rejection criteria.
- Method for documenting or recording test data and results.
- Designation of the individual(s) or group(s) responsible for evaluating and making decisions based on test results.

Test procedures shall be subject to document control as outlined in Section 4. They shall be maintained current by revisions issued upon changes in specifications, documentation, drawings, or contracts.

5.1.4 Test Control for Procured Items

Test control requirements shall be imposed on vendors by procurement documents to identify the tests to be performed and to stipulate that the vendor's test procedures be submitted for approval. The vendor's organization shall conduct these tests. Test control systems shall be monitored during Quality Assurance surveillances. Records of tests shall be reviewed for acceptability during surveillances.

5.2 HANDLING, STORAGE, AND SHIPPING

Measures shall be established and implemented to assure that all materials, components, assemblies, spare parts, special tools, and equipment, including packaging for shipment of radioactive or hazardous materials, are handled, stored, packaged and shipped in a manner which prevents damage, loss of identity, or deterioration. These activities shall be carried out in accordance with written approved procedures.

5.2.1 Handling

Material handling equipment shall be designed to preclude damage to both the equipment and its container. If special handling is needed, special requirements such as weights, sling locations,

balance points, methods of attachments, maximum hoist line speeds, and other pertinent features for safe and proper handling shall be identified in procurement and shipping documents, as necessary. Protective measures to preclude handling damage shall be included in the design. Procurement specifications shall indicate necessary requirements for packaging and shipping to prevent damage or deterioration. Items in storage shall be checked periodically by Project QA. Any loss or damage shall be reported as a non-conformance.

5.2.2 Storage

The owner or his agent defines normal storage requirements. If required, crating or any other type of packing should be accomplished prior to storage. A responsible engineer periodically shall survey items that are stored. Any damage or deterioration shall be reported as a non-conformance. When necessary, storage procedures shall address special requirements for environmental protection such as inert gas atmospheres, moisture, temperature levels, etc.

5.2.3 Shipping

Items shall be packaged and shipped in a manner that will prevent damage during transit. Items shall be packaged in accordance with appropriate codes, manufacturer's standards, contractual requirements, and shipping requirements. Procurement documents shall contain relevant shipping instructions and requirements. Items received and inspected at project facilities shall be repackaged in accordance with appropriate requirements for final shipment to the job site. Shipping procedures shall assure that all conditions of the Certificate of Compliance are satisfied prior to delivery of hazardous or radioactive material to a carrier for transport in an approved package. Shipping documentation shall be completed prior to shipping, as required.

5.3 SELF-EVALUATION

Self-evaluation on a project involves determining readiness to begin or continue work and determining the quality of completed work by the individuals and their supervisors immediately responsible for performing the work. Internal design reviews, quality control checks, and other inspections and tests conducted to gain and document immediate confidence in the work are also considered part of the self-evaluation process. Before beginning project quality-affecting activities, cognizant project personnel should perform readiness reviews of prerequisites to assure satisfactory preparation. Readiness reviews performed as self-evaluations should not be confused with safety-related Operational Readiness Reviews which, while similar in method and intent, are performed by personnel not directly associated with the work.

5.4 STANDARDS

Technical and other appropriate standards from external sources may be used to perform project work as designated in planning documents. Administrative controls for the project-specific implementation and documentation of these standards should be detailed in corresponding procedures (see Section 5.1).

5.5 IDENTIFICATION AND CONTROL OF ITEMS

Items that have been specifically designed to project requirements and that require traceability shall be assigned unique identification. Commercially available items that are procured by the project as standard "off-the-shelf" items should have identification requirements included in procurement documents if traceability is to be maintained. Data generated as a result of sampling, characterization, monitoring, or remedial activities shall be identified in the documents and information systems in which they appear. The identification of data shall include the origin of the data (e.g., task, test, experiment, or report) and shall be verified before release for use in order to assure traceability to the source(s). Quality-affecting samples shall have unique identification that trace them to their source(s) and shall be identified and controlled in a manner consistent with their intended use. Physical identification of items shall be used to the maximum extent possible. Identifying markings shall be permanent and legible and not adversely affect the function, service, or archival life of the item. When physical identification on the item is impractical, other methods should be used. Items with finite shelf life shall be controlled and physically identified. Methods for dispositioning items with expired shelf lives should be identified.

5.6 IMPLEMENTING PROCEDURES

ERG Technical Standard Operating Procedures (see Attachment 2 for listing)

SECTION 6: DESIGN

Items and processes shall be designed using sound engineering/scientific principles and appropriate standards. Design work, including changes, shall incorporate appropriate applicable requirements and design bases. Design interfaces shall be identified and controlled. The adequacy of design products shall be verified or validated by individuals or groups other than those who performed the work. Verification and validation work shall be completed before approval and implementation of the design.

ERG currently does not do design work and will not engage in such work until approved QA procedures are in place.

SECTION 7: PROCUREMENT

Procured items and services shall meet established requirements and perform as specified. Prospective suppliers shall be evaluated and selected on the basis of specified criteria. Processes to ensure that approved suppliers continue to provide acceptable items and services shall be established and implemented.

7.1 PROCUREMENT PLANNING AND PERFORMANCE

The procurement of quality-affecting or safety-related materials, components, or services shall be accomplished by developing procurement specifications and following an orderly process of evaluating available products or services.

7.1.1 Procurement Specifications

Requirements to be met by the vendor shall be detailed in the procurement documents, which may include procurement specifications. Procurement specifications may detail the aspects of vendor quality assurance, for example, inspection reports, provisions for inspection, equipment calibration prior to use, and provisions for inspection after component repair.

7.1.2 Item Identification

Identification requirements for procured items shall be determined during generation of specifications. Identification of materials and parts for quality-affecting or safety-related systems or components shall be traceable to the appropriate documentation, such as drawings, specifications, purchase orders, manufacturing and inspection documents, deviation reports, and physical and chemical test reports.

7.2 SELECTIONS AND ACCEPTANCE OF CONTRACTORS, ITEMS, AND SERVICES

Initial selection and continued qualification of subcontractors, vendors, and suppliers shall be based on an evaluation of their capability to provide items, services, or other products in accordance with the requirements of procurement documents before award of contract. Measures for evaluating and selecting procurement sources and the results thereof shall be documented. Methods for accepting project items or services shall be identified and subsequently incorporated into project contractual agreements, including methods for the disposition of project items and services that do not meet contractual documentation requirements.

The QA Manager shall participate in evaluation of procurement sources. Recommendations of procurement sources shall be based on these evaluations performed prior to contract award. The evaluations shall cover review of capabilities and facilities for technical, manufacturing and quality performance as applicable to the item or service to be procured and include any or all of the following:

- Historical performance data, particularly in product quality and delivery.
- Review and comment on vendor's quality assurance program.
- Source audits to verify vendor's implementation of his quality assurance program.
- Source qualification programs.

Actions to correct deficiencies in the vendor's organization or quality program shall be resolved with the vendor's management prior to initiation of work on the ordered items or services.

7.3 IMPLEMENTING PROCEDURES

ERG SOP 4.04 Procurement

SECTION 8: INSPECTION AND ACCEPTANCE TESTING

Inspection and testing of specified items, services, and processes shall be conducted using established acceptance and performance criteria. Equipment used for inspections and tests shall be calibrated and maintained

8.1 INSPECTION

Procedures shall be established and implemented to inspect materials, parts, processes or other activities affecting quality to verify conformance with documented instructions, procedures, specifications, drawings, or procurement documents. Inspections shall be performed in accordance with approved, written instructions and procedures that address the following as applicable:

- Acceptance criteria.
- The characteristics and activities to be inspected.
- The individuals responsible for performance of the inspection operations.
- The method of inspection.

When direct inspection is not possible, provisions are established for indirect control by monitoring processing methods, equipment and personnel. Modifications and/or repairs to and replacements of quality-affecting or safety-related components or equipment shall be inspected in accordance with the original design and inspection requirements or acceptable alternatives.

8.2 TEST CONTROL

Testing activities should be planned and documented by assigned personnel before commencing such work. Test planning should establish the activity characteristics to be verified. Planning should include or refer to test objectives and should assure that proper instrumentation is available and used, that necessary monitoring is performed, and that suitable environmental conditions are maintained to avoid degradation of the test item. Assigned personnel should conduct test activities in accordance with established testing methods. Personnel should assure that proper environmental conditions are maintained and that any deviations or nonconformances that may occur during tests are properly documented. Test results should be documented and evaluated by responsible personnel to assure that test requirements have been met. Modifications, repairs, and replacements shall be tested in accordance with the original design and test requirements or acceptable alternatives approved in the same manner as the original. Records of tests performed shall be prepared, showing the applicable drawing or procedure

revision, identification of test performed, date, test data, and other essential test information. The test record shall be signed by the individual performing the test and any test witness, if so required. Test records shall be retained, as quality records if applicable.

8.3 INSPECTION, TEST, AND OPERATING STATUS

The use of physical status indicators is necessary to assure that operations, support, and experimental activities important to quality, ES&H, and security are properly controlled. The status of inspection and test activities shall be identified, either on the items or in documents traceable to the items if necessary, to assure that required inspections and tests are performed and that failed items are not inadvertently used.

The inspection, test and operating status of systems and components used for quality-affecting or safety-related operations shall be known at all times. Operating personnel who are responsible for critical inspection, test and operating activities will maintain equipment status. QA personnel shall verify equipment status and compliance with procedures.

8.4 CONTROL OF EQUIPMENT FOR MEASURING AND TESTING

Equipment selection and procurement processes shall assure that such items are of proper type, range, accuracy, and tolerance to determine conformance to specified requirements that control any work process parameter that influences the quality of an item or process. Equipment should be identified through controlled inventory and physical marking with unique status identification. An equipment inventory shall be maintained.

When measuring and test equipment is found to be out of calibration, measures are taken and documented to determine the validity of inspections performed during the period the equipment was out of calibration. The complete status of all measuring and test equipment under the calibration system is recorded and maintained. Operational checks shall be performed on test equipment, as required, to assure that the equipment is still functioning properly prior to actual testing.

8.5 EQUIPMENT CALIBRATION

Equipment shall be calibrated, adjusted, and maintained at prescribed intervals against certified equipment having known valid relationships to nationally recognized standards such as the National Institute for Standards and Technology (NIST). The calibration of radiation detection instrumentation shall conform to ANSI N323-1978. If no nationally recognized standards exist, the basis for calibration shall be documented. All calibrations shall be performed in accordance with approved written procedures. Measuring and test equipment shall be identified and traceable to the calibration records and shall be labeled or tagged to indicate the next required calibration date. Equipment past its next date of calibration shall be removed from service, tagged, and segregated, if possible. If during recalibration, equipment is found to be out of calibration, it shall be immediately removed from service, tagged, and segregated, if possible. An evaluation to determine the effect and significance of the use of suspect data shall be

performed and documented. If the evaluation discloses an adverse effect on items, work, or data previously accepted, appropriate corrective action shall be taken.

8.6 IMPLEMENTING PROCEDURES

ERG Technical Standard Operating Procedures, as required (See Attachment 2 for listing).
ERG SOP 4.04 Procurement

SECTION 9: MANAGEMENT ASSESSMENT

Managers shall assess their management processes. Problems that hinder the organization from achieving its objectives shall be identified and corrected.

9.1 MANAGEMENT ASSESSMENT

The operations and project manager shall perform project management assessments. Management assessments shall focus on how well the project QA program is working by evaluating the appropriateness and effectiveness of its controls. Management assessments shall be performed periodically or as a needed. Management assessments should not be strict compliance checks. They should augment internal verification and self-evaluation practices and independent assessments by taking an overall look at the entire project QA program. Management assessments should focus on:

- Managerial effectiveness in establishing and implementing the QA program and achieving quality improvement, including the identification of management impediments and problems that may hinder effectiveness in meeting objectives.
- Adequacy of resources and personnel devoted to developing, implementing, and verifying the QA program.
- Effectiveness of established processes and activities in achieving and assessing requisite quality.
- Degree of success in meeting management objectives.
- Implementation of recommendations from past management assessments and independent assessments.

Management personnel shall gather data necessary to make effectiveness determinations, formally report on their conclusions, and take appropriate actions to address identified concerns and problems.

9.2 IMPLEMENTING PROCEDURE

ERG SOP 4.05 Audits

SECTION 10: INDEPENDENT ASSESSMENT

Independent assessments shall be planned and conducted to measure item and service quality, to measure the adequacy of work performance, and to promote improvement. The group performing independent assessments shall have sufficient authority and freedom from the line to carry out its responsibilities. Persons conducting independent assessments shall be technically qualified and knowledgeable in the areas assessed.

10.1 INDEPENDENCE AND RESPONSIBILITY

Independent assessments are formal project evaluations conducted by qualified personnel, free of responsibility in the areas they assess. The QA manager is responsible for coordinating independent assessments, as requested or regularly scheduled by clients, regulators, or other sources. Clients and regulators may conduct assessments of the project to their own specifications.

Project or corporate independent assessments of the project or a vendor shall provide comprehensive, independent verification and evaluation of the project or vendor activity being assessed and should focus on assisting project management in improving quality. The assessment scope shall encompass evaluation of quality system practices and/or procedures and the effectiveness of their implementation, monitoring of operations and activities, and a review of pertinent documents and their control and maintenance. These assessments should consider:

- The intended function of an item, system, or process.
- Attributes required to perform these functions.
- Processes or activities that impart these attributes.
- Degree of success in meeting acceptance criteria and performance objectives.
- Areas of previously identified concern.

Checklists shall be prepared prior to conducting an assessment.

10.2 SELECTION AND QUALIFICATION OF INDEPENDENT ASSESSMENT PERSONNEL

Independent QA and technical professionals shall conduct the assessments. They shall be familiar with the programmatic elements and requirements of the project QA program and experienced in assessment practices. In addition, the team leader shall be certified as qualified independent assessment team leader by their management. Instruction in planning, conducting,

and reporting independent assessments shall be provided to these personnel, as necessary, by the assessment team leader, in coordination with the QA manager. The makeup of an assessment team should be commensurate with the scope and time frame of the assessment.

10.3 ASSESSMENT FREQUENCY AND SCHEDULE

Internal independent assessments normally shall be conducted at least once every 12 months for continuing projects. However, unscheduled audits may be performed more frequently in specific areas, if deemed necessary by Project QA and/or when the need is indicated by the existence of chronic problems. Independent assessments shall be requested by the Project Manager and scheduled in consultation with the QA Manager. Assessments shall be based on the following considerations:

- How well the project QA program meets regulatory and other requirements.
- The activity's relative impact and importance to project objectives.
- Past independent assessment scope, frequency, and results.
- Past results of other project and external assessments, audits, or reviews.
- Availability of personnel, budget, and other resources.

10.4 ASSESSMENT PLANNING, ACCOMPLISHMENT, REPORTING, AND FOLLOW-UP

A documented plan that identifies the subject(s), dates, and schedules, assessment methods, assessment team members, and other necessary information shall be prepared by the assessment team leader and distributed to affected project personnel before the scheduled performance date. Independent assessment teams shall conduct and document assessments as scheduled and planned using accepted quality assurance techniques, including checklists. The project manager shall provide team access to necessary personnel, work areas, and resources. Results of investigations shall be discussed with responsible personnel at the time of identification and at the conclusion of the assessment.

Upon completion of the assessment, the team leader shall provide project management with a verbal description of the team's findings, conclusions, and quality improvement recommendations (if any) at a closeout meeting. As soon thereafter as possible, the team leader shall prepare a report detailing the results of the assessment provided at the closeout meeting. The Project Manager shall assign cognizant project management personnel, at the level necessary to effect change, to develop and document reported corrective actions and quality improvement actions. The assigned project management personnel shall evaluate each report item and correct deficiencies as promptly as possible. The assessment team leader or a designated alternate shall follow any open finding until action is taken by the project to satisfy the finding. Follow-up actions shall be taken to verify corrective actions are implemented and effective.

10.5 IMPLEMENTING PROCEDURES

ERG SOP 4.05 Audits

ATTACHMENT 1

ERG PROCEDURES

STANDARD OPERATING PROCEDURE 4.01
TRAINING, INDOCTRINATION, AND CERTIFYING PERSONNEL

1. PURPOSE

To describe the procedures for training, indoctrination, and certification of personnel.

2. DISCUSSION

This procedure supports the ERG QA Plan.

3. PROCEDURE

3.1 Position Requirements and Selection.

3.1.1 Management shall define the minimum educational, experience, and other qualification requirements for positions involved in the performance of project quality-affecting activities

3.2 Orientation and Training

3.2.1 Management shall assure that all personnel performing activities affecting quality are trained and indoctrinated as to the purpose, scope, and proper implementation of the QA plan. The specific QA requirements and task procedures to assure proficiency shall be emphasized. Documentation of training shall be done and placed in the project file.

3.2.2 Management shall assure that general and project-specific environment, safety, and health (ES&H) training shall be given to all personnel. Documentation of training shall be done and placed in the project file

3.2.3 The QA Manager is responsible for assuring that this orientation and training occurs prior to quality-affecting work begins.

3.3 Personal Certification

3.3.1 Personnel responsible for performance, inspection, and control of certain special processes and operations that require special skills and have an effect upon quality shall be certified. Confirmation of adequate training shall be documented through written exams, oral exams, task performance demonstrations, or other means. A record of the names of certified personnel, their skills, and certification periods shall be maintained in the project files.

3.4 Proficiency Evaluation

3.4.1 Immediate supervisors shall continuously monitor (maintain awareness of) personnel proficiency in understanding their job requirements, competently performing their assigned quality-affecting tasks, and progressively improving their capabilities. Formal evaluation of proficiency should be documented as part of the usual performance appraisal process. If an

individual's level of proficiency is unsatisfactory, project supervisors should, in addition to standard personnel actions, suspend the applicable job task, counsel the individual, and assign appropriate training or professional development.

4. TRAINING

4.1 Not applicable.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.3

7. ATTACHMENTS

None.

Author's Signature:	**Reviewed By:**

STANDARD OPERATING PROCEDURE 4.02
NONCONFORMANCE AND CORRECTIVE ACTION

8. PURPOSE

To describe the procedures for handling nonconformance items and corrective actions

9. DISCUSSION

This procedure shall be used for managing quality-affecting nonconformance items and corrective actions.

10. PROCEDURE

10.1 Identifying Nonconformance Items.

10.1.1 Project management is responsible for identifying quality-affecting items and services that do not conform to specifications or other procurement contract requirements. Items shall be tagged as nonconforming and held until proper resolution. If another contractor or vendor is involved, immediately notify Accounts Payable of the action and withhold payment in accordance with contract provisions. The first portion of ERG Nonconformance Form 4.02A shall be used to document this action. The QA Manager shall be advised of the nonconformance and subsequent actions

10.2 Documenting Corrective Action

10.2.1 Project management shall provide nonconformance data or information to the appropriate group, vendor, or contractor. A record of the resolution of the nonconformance shall be retained.

10.2.2 After the item or service has been repaired or reworked, an inspection shall be done to assure that it conforms to the original specifications.

10.2.3 Disposition of the nonconforming item or service shall be documented

11. TRAINING

11.1 Not applicable.

12. RECORDS

12.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

12.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

13. REFERENCES

13.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

14. ATTACHMENTS

14.1 None.

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 4.03
PROJECT AND QUALITY ASSURANCE RECORDS

15. PURPOSE

The purpose of this Standard Operating Procedure is to describe the procedures for maintaining project and quality assurance (QA) records.

16. DISCUSSION

This procedure shall be used for managing all quality-affecting project records, including contracts, statements of work, environmental health and safety records, instrument calibrations, field function check forms, project notes, and draft and final reports.

The Operations Manager is responsible for assuring that adequate space and resources are available for project files and that the files are archived for required length of time.

The Project Manager is responsible for establishing and maintaining project files in accordance with ERG standard filing format.

The QA Manager is responsible for auditing the files as part of the project quality audit.

17. PROCEDURE

17.1 Project Manager's Duties

17.1.1 The Project Manager shall, upon award of a contract, establish the file requirements and develop the Subject Matter File Index for managing all quality-affecting project records. Copies of calibration and other data sheets normally taken to the field shall be placed in the file. Field data shall be collected as soon as practical and placed in the files to prevent loss.

17.1.2 The Project Manager shall review the record requirements and data needs with project staff at the Project Opening Meeting (SOP 4.06). Lists are encouraged as a way to assure proper data collection and management.

17.1.3 The Project Manager is responsible for preparing the project files for archiving by culling unneeded material and assuring that the files are complete

17.2 Field Team Leader's Duties

17.2.1 Assure that all requirements are understood.

17.2.2 Assure that employees are adequately trained and supervised.

17.2.3 Assure that SOPs are understood and used for all quality related tasks.

17.2.4 Make copies of data for the project files at frequent intervals.

17.2.5 Never transport single-copy files without copies in another location

17.2.6 Assure that electronic files are managed in the same manner as hard-copy files.

18. TRAINING

None

19. RECORDS

None

20. REFERENCES

SOP 4.06

Form 4.00 Training Qualification Form

21. ATTACHMENTS

None

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 4.04
PROCUREMENT

22. PURPOSE

This procedure describes the procurement process for quality-related goods and services

23. DISCUSSION

This procedure shall be used for procuring all quality-related products or services. In cases where ERG has procurement requirements in contracts, these requirements and the additional contractual requirements will be followed. Contractual requirements will take precedent over these requirements where conflicts exist.

The Operations Manager is responsible for approving all quality-related purchases and assuring conformance with this procedure

24. PROCEDURE

Procurement specifications shall be prepared for the purchase of all quality-related items.

Requests for Bids shall be made for items and services unless a sole-source justification can be made. The Operations Manager must approve all Requests for Bids prior to submittal.

Upon receipt of products, an inspection must be made in accordance with SOP 4.02, Nonconformance and Corrective Actions.

The Operations Manager must approve the payment of all invoices in writing

25. TRAINING

Not applicable.

26. RECORDS

26.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

26.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

27. REFERENCES

27.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.02

28. ATTACHMENTS

None.

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 4.05
AUDITS

29. PURPOSE

This procedure describes the audit process.

30. DISCUSSION

This procedure shall be used as guidance in preparing audits of company management, projects, or other work-related organizations. The guidance relates to both internal assessments as well as independent assessments (external audits). Internal assessments may be less formal with less emphasis on formal evidence gathering and documentation.

Company Management is responsible for assuring that audits are performed to meet contract requirements and to satisfy the quality needs of the company. The QA Manager is responsible for assuring that the audits are performed according to company policy

31. PROCEDURE

31.1 Planning.

31.1.1 The auditor (or audit team) shall meet with the QA Manager to clearly define the goals and scope of the audit. Auditors will be selected that are familiar with the programmatic requirements and audit process. For technical audits, the auditors may also include technical specialists. Auditors for independent assessments shall truly be independent of the organization being audited.

31.1.2 Adequate information should be obtained for study by the auditors in order to gain a familiarity with the processes and quality requirements. An audit plan will be prepared showing participants, organizations, and schedule. This plan will be reviewed and agreed to by the QA Manager. The plan may include check lists.

31.2 Audit

31.2.1 The audit shall be conducted according to the plan. The auditor shall expect that compliance will be demonstrated by adequate documentation or other physical evidence.

31.2.2 Audit notes should be carefully taken to support the preparation of the audit report.

31.2.3 The audit team should convene a meeting where adequate time is allowed to prepare draft audit findings. These findings should be presented to management at the end of the audit

and prior to preparation of the audit report. Revisions to the draft findings may be considered if additional information is provided on which to make a change.

31.2.4 A final written audit report shall be prepared in a timely manner

31.3 Follow-Up

31.3.1 The organization being audited shall prepare a written response to the findings and commit to a corrective action and a completion date. These corrective actions may be the subject of a follow-up audit or may be included as topics on a regularly scheduled audit.

32. TRAINING

Not Applicable.

33. RECORDS

33.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

33.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

34. REFERENCES

34.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

35. ATTACHMENTS

None.

Author's Signature:	**Reviewed By:**

ATTACHMENT 2

LIST OF ERG TECHNICAL STANDARD OPERATING PROCEDURES

Series 1 Equipment Calibration and Setup

1.01 Calibration of Scaler, Ratemeter
1.02 Pancake Detector Calibration and Checkout
1.03 Alpha Scintillation Detector Calibration and Checkout
1.04 High Energy Gamma Scintillation Calibration and Checkout
1.05 Beta Scintillation Detector Calibration and Checkout
1.06 Gamma-Ray Spectroscopy Setup and Calibration
1.07 FIDLER Scintillation Detector Calibration and Checkout
1.08 NO LONGER USED
1.09 Alpha and Alpha-Beta Scintillation Tray Counter Calibration and Checkout
1.10 Gamma-Ray Spectroscopy Setup and Calibration Using MicroNOMAD
1.11 Gas Proportional Detector Calibration and Checkout
1.12 Dual Channel Scintillation Detector Calibration and Checkout
1.13 PIC Setup and Operation
1.20 Calibration of RAS-1 Intermediate Volume Air Sampler
1.21 Calibration of MSA Personal Lapel Air Sampler
1.22 Calibration of MSA ELF Personal Lapel Air Sampler
1.23 Radon Daughter Working Level Measurements
1.24 Thoron Daughter Working Level Measurements
1.30 Function Check of Equipment

Series 2 Project Related Tasks

2.01 Monitoring of Trucks for DOT Compliance
2.02 General Equipment Decontamination
2.03 Personal, Environmental, and Work Area Sampling
2.04 Monitoring of Rail Cars for DOT Compliance
2.05 Personal Access-Egress into Radiologically Controlled Areas
2.06 Radiation Work Permit
2.07 Radon Flux Canister Deployment
2.08 Monitoring for Ra-226 in Surface Soils using a gamma scintillation detector
2.09 Gamma-Radiation Correlation Studies
2.10 NO LONGER USED
2.11 Exposure Rate Survey
2.12 Monitoring Equipment for Access and Unconditional Release
2.13 External Dosimetry Procedure
2.14 Respiratory Protection Program
2.15 Sample Control and Documentation
2.16 Total Surface Contamination Measurements
2.17 Sampling for Removable Surface Contamination
2.18 Posting Requirements for Radiologically Restricted Areas
2.20 Sampling of Liquids and Solids
2.21 Sampling High-Efficiency Particulate Air Filters
2.22 Surface and Shallow Subsurface Soil Sampling
2.23 Vegetation Sampling

Series 4 Quality Assurance and Project Management

4.01 Training, Indoctrination, and Certifying Personnel
4.02 Noncomformance and Corrective Action
4.03 Project and QA Records
4.04 Procurement
4.05 Audits
4.06 Project Management
4.07 Project Logbook Guidelines
4.10 Technical Quality Control
4.12 Soil Data Validation

Series 5 GIS and Survey Systems

5.01 GIS-GPS Data and File Management
5.02 Creating Isometric and Data Contour Maps
5.03 Creating Grid Block Data
5.04 Creating Polygon Statistics of Survey Data
5.05 Creating, Uploading, and Navigating to Waypoints
5.06 Creating, Uploading, and Navigating to Shapefiles
5.11 Setup and Operation of Trimble Pro XRS GPS Receiver with Trimble TSCe Datalogger
5.12 Download, Correction, and Export of GPS Survey Data
5.13 Performing GPS Radiological Survey By Vehicle
5.14 Performing GPS Radiological Survey By Baby Jogger Pushcart
5.21 Setup and Operation of ERG 3-DISS
5.22 Setup of 3DISS Wireless Network
5.23 Configuration of Wireless Components (3-DISS)
5.24 Setting Up a 3DISS Survey
5.25 Setup and Operation of Remotely Operated Survey System (ROSS)
5.31 Setup and Operation of ERG RadMap System
5.32 Setup and Operation of ERG RadMap System in 2-D Mode

Appendix B

ERG Standard Operating Procedures

STANDARD OPERATING PROCEDURE 1.01
CALIBRATION OF SCALER/RATEMETERS

1. PURPOSE

To provide a standard method for the calibration of scaler/ratemeter instruments.

2. DISCUSSION

A scaler/ratemeter (meter) is used with a compatible probe/detector (detector) to measure radiation in rate and/or integrated scaler count modes. A meter is calibrated using a pulse generator, also known as a pulser. The pulser allows for the high voltage, threshold, window setting and digital/analog count rate to be tested.

3. PROCEDURE

3.1 Equipment

3.1.1 Portable meter: Ludlum Model 3, 12, 177, 1000, 2000, 2221, 2224, 2241, 2360, 2929, 3030 or equivalent.

3.1.2 A calibrated Ludlum Model 500 pulser.

3.1.3 Cable: C-C or other connectors, as applicable.

3.1.4 Flathead precision screwdriver.

3.1.5 Documentation

3.1.5.1 Obtain a blank Certificate of Calibration form for the appropriate instrument.

Note: Sample copies are included in this SOP as attachments. The most current calibration forms are on file, contained in the equipment database, or can be obtained from the equipment manager.

3.2 Calibration Procedure

3.2.1 Check the mechanical features including knobs, buttons, reset, audio and battery level for functionality. Check off the calibration form appropriately.

3.2.2 Connect the pulser to the meter being calibrated.

3.2.3 Check the high voltage at 500, 1000, 1500 volts to see if the meter readings matches the pulser readings. If so, then check the appropriate line on the calibration form. If the readings do not match, then refer to the Ludlum manual for that particular instrument on how to adjust the HV.

3.2.4 If applicable, determine if the threshold and window features are operating correctly. Not all meters will have a Window. Most will have a Threshold. On a few meters the Threshold is not adjustable.

3.2.4.1 Determine what the Threshold (THR) and Window (WIN) settings are on the meter. Use the THR and WIN buttons that display the settings when pressed. The window and thresholds are set according to which detector will be used with the meter.

3.2.4.2 By adjusting the amplitude on the pulser, check to see if the set displayed Threshold and Window settings correspond to the actual settings. If so then check the appropriate line on the calibration form. If it does not, refer to the manufacturer's manual.

3.2.5 Set the scale multiplier on the meter and check the ranges indicated on the appropriate calibration sheet. Set the count rate on the pulse generator to its highest reference setting indicated on the calibration sheet. Observe and record the instrument analog and/or digital reading. Repeat this for the remaining reference settings. Record this value in the "As Found" column. If the reading is not +/- 10% of what the pulser reads then use a precision screwdriver to adjust the appropriate potentiometer so the meter reading matches the pulser output. If unfamiliar with this process then refer to manufacturers manual.

NOTE: As the count rate and range setting are changed on the pulser, allow time for the meter analog needle movement to respond. It may take a few seconds for this to happen, especially if in slow response mode.

3.2.6 If the meter has the ability to take integrated counts (i.e., ability to collect counts for a set time span, for example: one minute) then perform a one-minute integrated count check and log scale check and record readings in the appropriate columns on the calibration form.

4. TRAINING

4.1 Prior to performance of calibrations, all personnel must show proficiency in the operation of the meter to be used.

4.2 Prior to performance of calibrations, all personnel must show proficiency in use of the calibration forms.

4.3 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1, 4.2, above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as hard copies and stored with equipment folders.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

ERG SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 Dual Channel Calibration Form

7.2 Single Channel Calibration Form

7.3 2929 & 43-10-1 Calibration Form

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 1.04
HIGH ENERGY GAMMA SCINTILLATION DETECTOR CALIBRATION AND CHECKOUT

1. PURPOSE

To describe the procedures for calibration and operational check-out of high energy gamma scintillation detectors employing ERG Standard Operating Procedures

2. DISCUSSION

This procedure applies to the Ludlum Model 44-2, 44-10 and 44-20 high energy gamma scintillator or equivalent.

3. PROCEDURE

3.1 Equipment

3.1.1 Portable ratemeter-scaler: Ludlum Model 3, 12, 2221, or equivalent.

3.1.2 Gamma detector: Ludlum 44-2, 44-10, 44-20, or equivalent.

3.1.3 Cable: C-C or other connectors, as applicable.

3.1.4 Record Forms: ERG Form 1.03A.1

3.1.5 Calibration source, typically a Cs-137 button source

3.1.6 Calibration Jig

3.2 Instrument/Detector Assembly and Electronic Set-Up (Calibration)

3.2.1 Attach the gamma detector to a portable ratemeter-scaler

3.2.2 Turn the instrument to the HV position. Note condition of battery as indicated by display. If the battery power is marginal, the batteries should be replaced.

3.2.3 Adjust the threshold setting on the ratemeter/scaler according to the users manual. Threshold for a Ludlum gamma scintillator is typically 10 mV.

3.2.4 Construct a Plateau Curve.

The operating voltage is determined based on the characteristics of a plateau curve. Curves are constructed every twelve months, after major repairs to a detector, and when a new detector is received. The plateau curve data are kept on file.

3.2.4.1 Place the detector in the calibration jig with the source in place.

3.2.4.2 Turn the high voltage down, then gradually increase the voltage until the meter begins to register counts. The speaker unit may now be turned off

3.2.4.3 Accumulate counts for 1-minute.

3.2.4.4 Record voltage setting and count rate. (ERG Form 1.03A.1)

3.2.4.5 Increase voltage to net higher multiple of 50 V.

3.2.4.6 Accumulate counts for 1 minute and record voltage and count rate.

3.2.4.7 Repeat 3.2.4.5 and 3.2.4.6 until the count rate begins to increase rapidly with increased voltage. The voltage should not exceed 1200 volts.

3.2.4.8 Prepare a graph of count rate vs. voltage. This graph should consist of a relatively flat section where there is little increase in count rate over a voltage range of up to several hundred volts. This voltage range is called the plateau region of the detector.

3.2.4.9 Select a voltage above the knee of the plateau region and indicate the value on the graph. Adjust the instrument voltage to this setting. Accumulate a background count for 1 minute and record. See Figure 1.03A

4. TRAINING

4.1 Prior to performance of calibrations or use in the field, all personnel must show proficiency in the operation of the high-energy gamma scintillation detectors.

4.2 Prior to use in the field, all personnel must show proficiency in use of the calibration forms.

4.3 Prior to use in the field, all personnel must show proficiency in and understanding of the MDA formula.

4.4 Prior to personnel being assigned to the field, a supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.3 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as hard copies and stored with equipment folders.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 1.30

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 Form 1.03A.1 – Voltage Plateau

7.2 Figure 1.03A – Plateau Curve

Author's Signature:	**Reviewed By:**

STANDARD OPERATING PROCEDURE 1.13
HIGH PRESSURE IONIZATION CHAMBER SETUP AND OPERTATION

1. PURPOSE

The purpose of the procedure is to instruct the user on how to properly setup and operate a High Pressure Ion Chamber (HPIC) to make gamma radiation exposure measurements

2. DISCUSSION

This procedure applies to the GE-Energy (formerly Reuter-Stokes) HPIC Model RSS-131, or equivalent.

3. PROCEDURE

3.1 Equipment

3.1.1 High Pressure Ion Chamber and tripod.

3.1.2 Cable.

3.1.3 Computer.

3.2 Setup

3.2.1 Load the RSS-131 software to laptop or desktop using the provided CD

3.2.2 Connect HPIC to laptop using RS232 cable.

3.2.2.1 Connect round 8-pin connector to COM Port 4 on HPIC

3.2.2.2 Connect DB-9 serial connector to COM 1 on computer.

3.2.3 Open RSS-131 Configuration Utility on computer.

3.2.3.1 From the configuration Utility you can change the HPIC settings such as logging time, format, etc. Refer to the RSS-131 manual for more details.

3.3 Operation

3.3.1 The HPIC logs reading whether or not it is connected to a computer. You can turn the detector on/off as needed between locations.

3.3.2 When the HPIC is initially turned on, the exposure rate readings will spike. After approximately 2-3 minutes the readings will have stabilized.

3.3.3 After the stabilization period, the HPIC will continue to collect readings according to the logging settings. The collection period should be defined by project specific instructions, but is typically 10 to 20 minutes per location.

3.3.4 At each location, the date, location, collection start and stop time should be noted in the field log book.

3.4 Downloading data

3.4.1 Upon completion of data collection, the data can be downloaded to a computer. Connect the PC to the HPIC according to section 3.2 or the HPIC User's Manual.

3.4.2 Open the Utility program, from the Online menu select the 'Upload sensor data from RSS-131' option. The data can be downloaded in .csv format. The data can be viewed, managed and displayed in Microsoft Excel.

4. TRAINING

4.1 Prior to use in the field, all personnel must show proficiency in the operation of the HPIC and associated computer program utilities.

4.2 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as print and/or electronic files and stored with field notebooks and/or equipment folders or files.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 No Attachments.

Author's Signature:	**Reviewed By:**

STANDARD OPERATING PROCEDURE 1.30
FUNCTION CHECK OF EQUIPMENT

1. PURPOSE

To describe the procedures for operational check-out and function check of radiation detectors and meters prior to collecting data.

2. DISCUSSION

The site manager is responsible for assuring that this procedure is implemented. The survey team members are responsible for following the procedure. It is imperative that the equipment is properly function checked each day of use and documented.

3. PROCEDURE

3.1 Equipment

3.1.1 Ratemeters and/or Scalars including Ludlum Models 2221, 2241, 3, 12, 19, 2360, or equivalent

3.1.2 Detectors including Ludlum models 44-10, 44-9, 44-2, 44-116, 43-5, 43-89, 43-93, or equivalent

3.1.3 Cable: C-C or other connectors, as applicable

3.1.4 Record Forms: ERG Form 1.30A (single channel detector) or 1.30B (dual channel detector)

3.1.5 Radiological check sources, typically Th-230 (alpha), Tc-99 (beta), and/or Cs-137 (gamma) sources

3.1.6 Calibration Jig

3.1.7 Instrument Manuals

3.2 Initial Instrument Field Check Out.

3.2.1 The following instructions should be followed unless otherwise directed by Project Manager.

3.2.2 Create a Function Check Form for each piece of equipment being used. Record serial numbers, calibration dates, and check source information in the appropriate fields. Under comments, record source to detector distance, site name, and location on site where function check is performed.

3.2.3 Check the instrument to assure that the settings are consistent with the calibration data. This means the Battery, High Voltage, Threshold, and Window Settings must be set

according to those used in the original calibration or set up. Check with the Project Manager if in doubt or if changes are necessary for site specific reasons.

3.2.4 Replace the batteries in the meter if they indicate that they are near the low voltage level. Record all settings including the battery voltage on the Function Check Form.

3.2.5 With the meter in the rate meter position and a meter scale selected so that the meter is not pegged (other than the log scale), move both ends of the detector cable to determine if the cable is functioning properly. A faulty cable will introduce spurious counts. To test a cable, move both ends of the cable watching the meter. If excessive counts occur the cable may be faulty. Replace with a new cable of identical size and repeat the test. Document faulty cable and dispose of cable.

3.2.6 Select a location to perform the function check. This location should be selected with the following conditions in mind:

3.2.6.1 The location should represent background conditions for the site.

3.2.6.2 The radiological conditions surrounding the location should be expected to remain consistent throughout the duration of the project.

3.2.6.3 This will be the location that all function and source checks will be performed at the beginning of the work day and the end of the work day for the duration of the project.

3.2.7 With the detector placed in the fixed geometry position with no radioactive check source present, perform 1-minute scaler count and record the background count rate on the Function Check Form. Unless directed otherwise by the Project Manager, repeat until ten background readings are recorded.

3.2.8 Repeat the 1-minute scaler counts with the radioactive check source in place. Record the results on the Function Check Form. Unless directed otherwise by the Project Manager, repeat until ten background readings are recorded.

3.2.9 With Project Managers assistance determine the acceptable daily function check range. Typically this range will be the average of the initial ten counts plus or minus ten percent.

3.3 Daily Function Check.

3.3.1 The daily function check is typically performed twice daily, once before work activities have commenced and a second time when work activities have been completed. Follow steps 3.3.3 – 3.3.6 below for each time a function check is performed. If equipment is used for only a brief period of time, less than 1 hour, then a single daily pre-operations function check may be necessary.

3.3.2 Create a Daily Function Check form for each piece of equipment being used as described in 3.2.2 above. In the comments field note that the form is being used as a daily function check form.

3.3.3 Follow steps 3.2.3 – 3.2.5 above.

3.3.4 Measure the background count for one minute (unless otherwise directed by project manager) at the previously identified function check location (see 3.2.6 above). Record on the Daily Function Check form.

3.3.5 Repeat 3.3.4 with the check source in place. If the detector is dual channel (alpha/beta) then repeat again with the second source in place.

3.3.6 If the daily function check results do not fall within the acceptable daily function check range, as discussed in Section 3.2.9 above, check the source, geometry and immediate area to determine if anything may have caused the check to fail. If a reason is found attempt to fix the problem. Count again. If the daily function check results in a second failure remove the instrument from service and report the event to the Project Manager.

4. TRAINING

4.1 Prior to performance of calibrations or use in the field, all personnel must show proficiency in the operation of the detectors and meters being utilized.

4.2 Prior to use in the field, all personnel must show proficiency in use of the function check forms.

4.3 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.2 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as hard copies and stored with instrument folders and/or project files.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 Form 1.30A – Function Check Form (Single Channel)

7.2 Form 1.30B – Function Check Form (Dual Channel)

Author's Signature:	**Reviewed By:**

STANDARD OPERATING PROCEDURE 2.08
MONITORING FOR RADIUM-226 IN SURFACE SOILS USING A GAMMA SCINTILLATION DETECTOR

1. PURPOSE

This procedure covers the use of gamma scintillation detectors for monitoring Ra-226 concentrations in soil. The soil concentrations are assessed by measuring the gamma exposure rates or gamma count rates and comparing them to previously determined gamma action levels. These action levels were derived from correlation studies completed earlier.

2. DISCUSSION

Monitoring of surface soils for Ra-226 is done for two purposes. Excavation control monitoring is done to determine if the readings are sufficiently low to assure that the area meets applicable cleanup criteria. The measurements are more informal and are normally not documented. Monitoring for verification is a more formal process where the grid block locations and gamma readings are formally documented.

3. PROCEDURE

3.1 Equipment

3.1.1 Ratemeter/Scaler.

3.1.2 Detector.

3.1.3 Collimator (if specified).

3.1.4 Check Source

3.1.5 Field notebook or appropriate forms.

3.2 Excavation Control Monitoring Using a Ludlum Model 19

The Ludlum Model 19 may be used to assess the approximate Ra-226 concentration in windblown contaminated soils. The gamma action levels are determined during calibration studies for the site and are provided in the Soil Cleanup Verification Survey and Sampling Plan, or equivalent. Care must be taken to assure that the conditions are the same as those that existed during the calibration studies.

3.2.1 The Model 19 should preferably be the same instrument as that used in the calibration studies. In any case, the instrument should have been calibrated at the same calibration facility using the same calibration source.

3.2.2 The instrument should be used in areas free of significant gamma shine from the tailings pile or other external sources.

3.2.3 The instrument should be held at approximately 1 meter height (waist level).

3.2.4 The meter reading should be observed over a period of time to obtain the average reading. When using the "fast response" mode, a five second observation period is normally adequate; when using the "slow response" mode, a 20 second observation period is normally required to obtain a good estimate of the average reading. The average reading should be compared to the action level.

3.2.5 When determining whether a grid block is likely to meet the cleanup criteria, use the fast response setting and slowly walk over the entire area, looking for areas that greatly exceed the average value. You may wish to mark these areas for further cleanup provided they are above the action level. After further cleanup, repeat the measurements until you are satisfied that the area has a high probability of meeting the standards.

3.3 Excavation Control Monitoring Using a Ludlum Model 2210/44-10

The Ludlum Model 2221/Ludlum 44-10 combination may be used to assess the approximate Ra-226 concentration in windblown contaminated soils. The gamma action levels were determined during calibration studies for the site for this combination of scaler/detector and are provided in the Soil Cleanup Verification Survey and Sampling Plan for the site, or equivalent. Care must be taken to assure that the conditions are the same as those that existed during the calibration studies. Since detectors vary in efficiency, it is best to use the same detectors that were used in the calibration studies. Assure that the high voltage, input sensitivity, cable type and length, and all other parameters are the same as those used in the calibration studies. Compare the function check results to those obtained during the calibration studies.

If the equipment used in the calibration studies is not available, the detector/scaler used must be evaluated to determine whether it can be adjusted to match the values used in the calibration studies. The same check source should be used at the identical location in the same geometry configuration as was use in the function check for the calibration studies. If adjustments cannot be made so that the detector responses agree for both

background count rate and source count rate conditions, other detectors should be evaluated until a match is found.

3.3.1 The instrument should be used in areas free of significant gamma shine from the tailings pile or other external sources. For gamma shine areas or for working in ditches or near embankments, the results using the lead shield will be more accurate than for the bare detector. However, remember that it is easier to miss contaminated areas when using the collimated shielded detector.

3.3.2 The instrument should be held at approximately 18 inches above the ground, if bare, and approximately 6 inches above the ground if in the lead collimating shield that was used in the calibration studies.

3.3.3 The meter reading should be observed over a period of time to obtain the average reading. When using the "fast response" mode, a five second observation period is normally adequate; when using the "slow response" mode, a 20 second observation period is normally required to obtain a good estimate of the average reading. The average reading should be compared to the action level.

3.3.4 When determining whether a grid block is likely to meet the cleanup criteria, use the fast response setting and slowly walk over the entire area, looking for areas that greatly exceed the average value. Mark these areas for further cleanup provided they are above the action level. After further cleanup, repeat the measurements until you are satisfied that the area has a high probability of meeting the standards.

3.3.5 For a more accurate and precise measurement, set the Ludlum 2221 switch to scaler mode and walk over the area for one minute while taking an integrated count. Compare this value to the action level for that detector.

3.4 Soil Cleanup Verification Using the Ludlum 2221/Ludlum 44-10 detectors

The calibration studies were done to support the use of these instruments to verify that the cleanup criteria are met. A land survey team should be employed to establish a 100 square meter grid (or approximately equivalent) across the area of interest. The site grid block nomenclature should be followed.

Follow steps in Section 3.3, paying special attention to assuring that the instruments are working the same as they did in the calibration studies. This should be carefully documented. If the same instruments are not available, the data to support equivalency should be carefully documented and approved by the designated manager prior to use.

While walking the grid block for the one-minute integrated count, develop a walking pattern and speed so that complete and uniform coverage is attained. This may require some effort and practice. Normally a brisk walking of lines 3-4 feet apart will result in near-complete coverage.

Document the results for each grid block by recording the Grid Block Number and the integrated one-minute count.

4. TRAINING

4.1 Prior to use in the field, all personnel must show an understanding of radiological posting requirements.

4.2 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.3

Form 4.00 Training Qualification Form

7. ATTACHMENTS

None.

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 2.09
GAMMA-RADIATION CORRELLATION STUDIES

1. PURPOSE

This procedure outlines the procedures for creating a correlation between gamma-radiation surveys and either the exposure rate or radium-226 (Ra-226) concentrations in the soil.

2. DISCUSSION

This procedure provides information on creating correlations from surveys performed with ERG GPS-based gamma-radiation survey systems. The data from the gamma-radiation surveys is correlated to exposure rate measured by either a pressurized ion chamber (PIC), Ludlum Model 19, or similar instrument. The gamma-radiation may also be correlated to the Ra-226 soil concentration. This procedure assumes that gamma-radiation survey has already been performed.

Regardless of what correlation is being done, the method is similar. A GPS-based gamma-radiation survey is performed. Points representing the range of values of the survey are selected. At these locations measurements are made (i.e., exposure rates measured by PIC). An XY plot of the data can then be created and a linear regression performed to create an equation correlating gamma-radiation values to the measurement in question.

3. PROCEDURE

3.1 Equipment

3.1.1 Ratemeter/Scaler.

3.1.2 Detector.

3.1.3 Collimator (if specified).

3.1.4 Field notebook or appropriate forms.

3.1.5 Indelible ink pen.

3.1.6 Necessary equipment for making correlation measurements.

3.1.7 Soil sampling equipement if necessary.

3.1.8 Post-hole digger or other tools capable of obtaining 6-inch deep soil sample.

3.2 Data Collection

3.2.1 Point Studies

3.2.1.1 Using gamma radiation survey data, locate study areas that represent the range of values present. Five or more readings are usually sufficient. Areas should not

be in shine areas and should be on relatively flat terrain. Each study area should be large enough that a few steps in any direction should not affect the reading. Record the data for each location on ERG Form 2.09A or field notebook.

3.2.1.2 At each area, make a measurement using the specified equipment. Refer to the SOPs pertinent to the equipment being using for more information.

3.2.1.3 Using the same gamma detector and ratemeter/scaler used during the gamma-radiation survey, make a series of integrated counts in the immediate vicinity of the sample location. These values should be recorded on Form 2.09A, field logbook, or equivalent.

3.2.1.4 Repeat steps 3.2.1.1 through 3.2.1.3 for each location.

3.3 Linear Regression

3.3.1 In Microsoft Excel or other appropriate program, enter the data collected above.

3.3.2 Plot the data in an XY scatter plot.

3.3.3 Add a trend line and equation to the plot.

3.3.3.1 This equation is the linear regression and can be used to predict values over the range of gamma-radiation counts found during a survey.

4. TRAINING

4.1 Prior to use in the field, all personnel must show proficiency in the operation of the gamma-radiation survey equipment.

4.2 Prior to use in the field, all personnel must show proficiency in the use of Microsoft Excel or other equivalent program to create scatter plots and trend lines.

4.3 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.2 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 Form 2.09A

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 2.15
SAMPLE CONTROL & DOCUMENTATION

1. PURPOSE

To define the steps necessary for sample control and identification, data recording and chain-of-custody documentation.

2. DISCUSSION

This procedure describes the typical method for sample control and documentation at a work site. Sample control and documentation are necessary to maintain an organized sample inventory for analysis and Quality Assurance. Documents typically used for sample control include but are not limited to: log books, sample logs, sample labeling , chain-of-custody forms, and analytical records.

3. PROCEDURE

3.1 Equipment

3.1.1 Sample Logs.

3.1.2 Logbooks.

3.2 Sample Labeling

3.2.1 Typically, samples collected at a work site include soil and air samples. If the client does not have a standard nomenclature system for naming samples, then a sequential system should be developed which includes groups of letters and numbers identifying the type of sample as well as relating it to the project or site name.

3.2.2 Use soil and air sample labeling on containers to identify the sample. Soil samples are typically collected in plastic re-sealable bags and should be uniquely identified with a permanent marker. Collected air samples can be placed into coin envelopes which have been pre-stamped with the date, time on and time off, sample number, air sampler serial number, beginning and ending flow rates and vacuum reading if applicable.

3.2.3 A logbook may be used to record pertinent information regarding the sample. For specific information regarding the use of the logbook, refer to SOP 4.07. Information put in logbook might include collection method, sampling crew, location (GPS or descriptive).

3.3 Chain-of-Custody

3.3.1 The primary purpose of the Chain-of-Custody is to create a written record that can be used to trace the possession and handling of the sample collected.

3.3.2 To transfer custody of a sample, a Custody Transfer Record (Form 3.02A) or equivalent analytical laboratory form can be used. The appropriate sections must be filled out to instruct the laboratory to perform the analysis required for the samples collected. The transferee must sign and record the date and time to relinquish custody of the samples to the analytical laboratory.

3.3.3 Send all packages to the laboratory with the Chain-of-Custody record. Retain a copy of these forms at the site office.

4. TRAINING

4.1 Prior to use in the field, all personnel must show proficiency in the operation of the beta scintillation detectors.

4.2 Prior to use in the field, all personnel must show proficiency in use of the calibration forms

4.3 Prior to use in the field, all personnel must show proficiency in and understanding of the Plateau Curve.

4.4 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.3 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.3

SOP 4.07

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 Form 3.02A – Custody Transfer Record/Lab Work Request Form

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 2.22
SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING

1. PURPOSE

This procedure outlines the appropriate equipment and materials, methods, and recordkeeping requirements for collecting surface and shallow subsurface soil samples from project locations.

2. DISCUSSION

Soil samples are used to assess the distribution and intensity of constituent of concern for a wide variety of applications ranging from characterization of undisturbed areas to verification that remedial activity goals have been attained. Soil samples may be collected at systematic locations on a routine frequency or they may be collected at discrete or random locations to assess the impacts of unplanned releases, spills, or other contamination events. The analytical requirements placed on soil samples depend on the type and proximity to the project area and the desired reporting radiological, chemical, and geochemical characteristics. This information is typically described in the project sampling plan.

Surface soil samples are defined as samples coming from an interval of ground surface to a depth of 15 cm below ground surface (BGS). Shallow subsurface samples are defined as samples coming from an interval ranging from 15cm BGS to 1.5 m BGS, in which hand sampling methods are adequate to sample the desired interval. Samples taken below 5 ft BGS typically require mechanized methods of collection including motorized augers and drill rigs..

3. PROCEDURE

3.1 Soil Sampling Process

3.1.1 Identify sample locations using work plan maps or work instructions with GPS equipment. Mark locations with pin flags or equivalent if soil sample is not to be collected immediately to prevent having to re-navigate back to the point.

3.1.2 Clear debris, loose brush, and vegetation from sample locations.

3.1.3 Collect the soil sample using shovel and trowel methods for surface soil samples and hand augers or equivalent for shallow subsurface soil sample collection. Samples should be collected in a heavy duty Ziplock plastic bag or equivalent.

3.1.4 Collect auger cuttings for the desired depth by measuring the depth of the auger bit. For example, cuttings from an auger penetration interval of 24 to 30 inches are

appropriate for required a sample of that depth. If used, drive sampling tubes to the desired depth and extract by hand or hand jack. Cap the end of the sample tube upon removal.

3.1.5 Add preservatives or otherwise prepare containers according to special instructions from the project manager or as described in the work plan. Document the sample ID, depth, preservation method, location, and other important sample descriptions

3.1.6 Collect quality control samples as directed in the work plan or project manager.

3.1.7 If using sampling equipment for multiple locations, wash surfaces of the tools with deionized water and dry prior to use at another sample location. Release rinse water to the ground unless the work plan or project manager designates that it be retained.

3.1.8 Fill out laboratory provided or ERG chain of custody (COC). Once all samples are collected, seal transport container with COC seals and prepare transport container for courier pick up.

3.1.9 All samples obtained will be sent to the analytical laboratory designated by the work plan or project manager.

4. TRAINING

4.1 Prior to use in the field, all personnel must demonstrate an understanding of the soil sampling process.

4.2 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.3

Form 4.00 Training Qualification Form

7. ATTACHMENTS

None.

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 4.10
TECHNICAL QUALITY CONTROL

1. PURPOSE

To describe the quality control program for conducting site activities employing ERG Standard Operating Procedures

2. DISCUSSION

This procedure applies to all site personnel employed by ERG or subcontractor employees. This procedure applies to all tasks designated in the QA/QC Plan. At a minimum, all measurements related to health and safety, contamination control, and final verification measurements will be done following this procedure.

3. PROCEDURE

3.1 Personnel Training and Management

3.1.1 It is the Corporation's responsibility to assure that a site manager or team leader is chosen who has the proper training and talents to manage all operations anticipated at the site. In addition, it is the team leader's responsibility to assure that all personnel are properly trained and suited to perform the duties expected of them..

3.1.2 The team leader must identify all tasks associated with a project and assure that ERG Standard Operating Procedures are appropriate and applicable. A Training Qualification Form must be developed for documentation of training for each technician. An example of this form is attached.

3.1.3 For each task that a technician performs, the technicians must review the procedure and demonstrate that they can perform the task satisfactorily. For difficult tasks or for junior technicians, a period of time may be required when the technician works with a qualified technician before being officially qualified to perform the tasks. At that time, the team leader will sign the Training Qualification Form for that task. It is everyone's responsibility to assure that tasks are only performed by qualified staff.

3.1.4 It is the team leader's responsibility to periodically provide training and to monitor the performance of tasks

3.2 Performing Tasks

3.2.1 The ERG Standard Operating Procedures must be readily available to all personnel. Data forms specified in the procedures will be placed in a central location and appropriately labeled.

3.2.2 All data must be recorded on the appropriate form using a black waterproof pen. Any changes must be made by a single line through the entry and initialed and dated by the technician. If it is necessary to recopy the entire form, the old form must be properly noted and attached.

3.2.3 All technicians are responsible for assuring that the instrumentation used is calibrated, function checked, and otherwise working properly before making a measurement.

3.2.4 All technicians are responsible for reviewing all paperwork prior to submitting to the authorized individual. In particular, all paperwork must be completed, dated, and signed by the technician(s) prior to submittal.

3.3 Quality Reviews

3.3.1 All data forms must be reviewed by the team leader or his/her designee within 24 hours of data collection

3.4 Quality Audits

3.4.1 For projects lasting more than six months, an annual Quality Audit must be conducted to assure that this procedure is being followed

3.5 Records

3.5.1 Records of the completed work, measurements and data must be preserved, protected and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

4. TRAINING

Not Applicable.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 4.00 Training Qualification Form

Author's Signature:	**Reviewed By:**

STANDARD OPERATING PROCEDURE 4.12
SOIL DATA VALIDATION

1. PURPOSE

The purpose of this procedure is to define criteria for assessing soil sample data quality. This procedure addresses data validation for radionuclides and inorganic analytical laboratory results for soil samples and assignment of data qualifiers. The data validation process includes an evaluation of raw analytical laboratory data to assess the quality of results. Data validation may also include evaluation of field data, holding times, chain-of-custody forms, instrument detection limits, calibration and internal standards, laboratory blanks, laboratory control standards, laboratory duplicate analyses, field duplicate analyses, matrix spike sample analyses, intermethod comparisons, interference sample analyses, duplicate injection and post digestion spike analyses, serial dilution analyses, and data completeness.

2. DISCUSSION

This procedure supports the ERG QA Plan.

The level of validation for the soil data is based on the intended use of the data, as determined on a project-by-project basis.

3. DEFINITIONS

Data validation - a process that applies performance-based criteria to data that may result in qualification of the data. The process is performed independently from the data generator, before conclusions are drawn from the data. In this procedure, the term also includes evaluations of the completeness, correctness, consistency of the data, and proper conformity.

Field parameters - In this procedure, field parameters that require validation are related to completeness of documentation; e.g., proper identification of soil sample locations on soil sample logs and verification of signatures and dates on the chain-of-custody (COC).

Laboratory Control Standard (LCS) - any Quality Assurance/Quality Control (QA/QC), reference, or control sample that is included in the daily analysis to assess the accuracy of the result.

Laboratory QC Report - the portion of the laboratory report that addresses QC criteria, consisting of laboratory blank, LCS percent recovery, relative percent differences in laboratory duplicates, and spike recovery.

Holding time - the time between sample collection and analysis. Each analytical method establishes a holding time to ensure that samples are not affected by analyte degradation.

Method Detection Limit (MDL) - the minimum concentration of a substance that can be distinguished from the absence of that substance (a blank value) within a stated confidence limit. The method detection limit is equivalent to the lower limit of detection (LLD) and the instrument detection limit (IDL) in this procedure.

Precision - A measure of agreement of individual results of a constituent in the same sample.

Quality Control (QC) criteria - in this procedure, QC criteria may include preservation, holding time, blanks, duplicates, COC completion, project-specified MDLs, laboratory calibrations, LCS recoveries, and matrix spike recoveries.

4. PROCEDURE

Table 1 lists the criteria considered during data validation and the associated section in which they are discussed.

If preliminary validation of the data has been performed for other requirements (e.g., invoice approval), then the validator may use its results to fulfill the requirements of this procedure.

Table 1
Criteria Considered During Data Validation

Data Evaluation Elements	Procedure Section
Field Data Validation	4.1
Holding Time	4.2
Chain-of-Custody	4.3
Method Detection Limits	4.4
Calibration and Internal Standards	4.5
Laboratory Blanks	4.6
Laboratory Control Standards	4.4
Laboratory Duplicate Sample Analyses	4.8
Field Duplicate Sample Analyses	4.9
Matrix Spike Samples	4.10
Furnace Atomic Absorption QC Analyses	4.11
ICP-MS Serial Dilution Analysis	4.12
Inter-method Comparisons	4.13
Data Completeness	4.14
Sample Results Verification	4.15

4.1 Field Data Validation

4.1.1 Objective - The objective for review of select field data is to determine if the soil samples were collected and the effort documented properly for preliminary evaluation of the analytical results. Field data validation will consist of verification of the field log-book and sampling documents.

4.1.2 Criteria - Records will be reviewed to identify transcription errors and ensure that adequate documentation was attained.

4.1.3 Evaluation Procedure - The validator will verify that the sample locations are recorded on a scaled map or identified by geopositions. The validator will also evaluate field notes to verify that the conditions, equipment, samples, procedures, and samplers were recorded. Field notes will include sample identification, location, type, date and time of collection, sample depth, and associated observations. The validator will review the field notes and verify that information is consistent with the COC and the laboratory report.

4.1.4 Action - Discrepancies will be investigated. Discrepancies that cannot be resolved may require the validator to qualify the data based on professional judgment.

4.2 Holding Times

4.2.1 Objective - The objective is to assess the quality of the results based on the holding time defined by the method from time of sample collection to analysis.

4.2.2 Criteria - Calculate the holding time from the COC and laboratory records as follows:

Analyte Holding Time (days) = Analysis Date - Sampling Date

4.2.3 Evaluation Procedure - The validator will verify that the sample locations are recorded on a scaled map or identified by geopositions. The validator will also evaluate field notes to verify that the conditions, equipment, samples, procedures, and samplers were recorded. Field notes will include sample identification, location, type, date and time of collection, sample depth, and associated observations. The validator will review the field notes and verify that information is consistent with the COC and the laboratory report.

4.2.4 Action - If a criterion for the holding time was not met, qualify all results greater than the MDL as estimated (J) and results less than the MDL as non-detected, estimated (UJ).

4.3 Chain-of-Custody Forms

4.3.1 Objective - The objective is to evaluate the COC forms to determine that the appropriate information was entered and sample control maintained. The COC form provides a record of possession and handling of a soil sample from the point of collection through laboratory receipt. A sample is considered to be in someone's custody if it is in their actual physical possession, within their view, sealed in a closed container, or kept in a secure area that is restricted to site personnel. When possession of the samples is transferred, the transferee will sign and record the date and time on the COC, which will accompany the sealed containers. Each person -- within a particular organization and location-- who takes custody of the samples is required to fill in the appropriate section on the COC.

4.3.2 Criteria - Records will be compared to identify transcription errors and to verify that sample transfer was adequately documented.

4.3.3 Evaluation Procedure - The validator will verify that the COC has been completed properly. Verification will consist of confirmation of: 1) project name, laboratory of destination, sampler's name and affiliation, site, sample identifier, date sampled, analytical parameters, number of containers, delivery method, signature, and date relinquished; and 2) samples received in good condition with legible labels and properly logged in by the laboratory. In addition, it will be verified that the analytes requested on the COC match those listed in the laboratory report. Samples that have been received in unacceptable condition may require re-sampling.

4.3.4 Action - Discrepancies between the COC, parameter list or the laboratory report will be clarified before further validation. Discrepancies that cannot be resolved may require the validator to qualify the data based on professional judgment. The validator will document all such discrepancies and, as applicable, justification for qualifying the data.

4.4 Method Detection Limits

4.4.1 Objective - The objective is to evaluate data quality by comparing the MDLs reported by the laboratory with those specified in the associated work plan.

4.4.2 Criteria - MDLs are specified in the associated work plan.

4.4.3 Evaluation Procedure - The validator will compare the MDLs associated with results in laboratory reports to the MDLs specified in the associated work plan.

4.4.4 Action - If the MDL has been exceeded for an analyte that has not been detected in the sample, the data may be qualified as J. If the analyte is reported above detection levels, laboratory-reported MDLs greater than work plan-specified MDLs are acceptable.

4.5 Calibration and Internal Standards

4.5.1 Objective - Requirements for instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analysis run, and continuing calibration verification (CCV) documents that the initial calibration is still valid.

4.5.2 Criteria

Initial Calibration

Instruments must be calibrated daily and each time the instrument is set up.

a. *Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) Analysis*

A blank and at least one standard must be used in establishing the analytical curve.

b. *Atomic Absorption Analysis*

A blank and at least three standards, one standard must be at the Contract Required Detection Limit (CRDL) used in establishing the analytical curve. The correlation coefficient must be greater than or equal to 0.995.

c. *Fluorimetric Analysis*

A blank and three standards must be used in the calibration.

d. *Alpha Spectroscopy Analysis*

Calibration frequency is governed by daily performance check results for each instrument detector. Control charts are maintained of the daily performance check standard and instrument control for each detector must be within 3σ error. A daily background check is also performed and must be within 3σ error.

e. *Gamma Spectroscopy Analysis*

Calibration frequency is governed by daily performance check results for each instrument detector. Control charts are maintained of the daily performance check standard and instrument control for each detector must be within 3σ error. A daily background check is also performed and must be within 3σ error.

Continuing Calibration Verification

a. *ICP-MS Analysis*

Results must fall within the control limits specified in the associated work plan. The frequency of the continuing calibration must meet contract specified critieria.

b. *Atomic Absorption Analysis*

Results must fall within the control limits specified in the project specific sampling plan. The frequency of the continuing calibration must meet contract-specified critieria.

c. *Fluorimetric Analysis*

Results must fall within the control limits specified in the associated work plan. The frequency of the continuing calibration must meet contract-specified critieria.

d. *Alpha Spectroscopy Analysis*

Results must fall within the control limits specified in the associated work plan.

e. *Gamma Spectroscopy Analysis*

Results must fall within the control limits specified in the associated work plan.

4.5.3 Evaluation Procedure

a. *ICP-MS Analysis*

1. Verify that the instrument was calibrated daily and for each setup using the correct number of standards and blanks.
2. Where the number of calibration standards used is greater than or equal to 3, verify that the correlation coefficient is greater than or equal to 0.995. Where the number of calibration standards used is less than 3, analysis of the check standard and calibration verification must yield recoveries of 90 - 100%. Replicate integrations (minimum of two), when reported, must yield a relative standard deviation (RSD) less than 5%.
3. Recalculate one or more of the ICV and CCV %R using the following equation and verify that the recalculated value agrees with the laboratory reported value.

$$\%R = \frac{Found}{True} \times 100$$

where,

Found is the concentration of each analyte measured in the analysis of the ICV or CCV
True is the concentration of each analyte in the ICV or CCV standard

Because of possible rounding discrepancies, allow results to fall within 1 percent of the specific range.

b. *Atomic Absorption Analysis*

1. Verify that the instrument was calibrated daily and each time the instrument was set up using the correct number of standards and blanks.
2. Verify that the correlation coefficient is greater than or equal to 0.995
3. Recalculate one or more of the ICV and CCV %R using the following equation and verify that the recalculated value agrees with the laboratory reported values.

$$\%R = \frac{Found}{True} \times 100$$

where,

Found is the concentration of each analyte measured in the analysis of the ICV or CCV

True is the concentration of each analyte in the ICV or CCV standard

Because of possible rounding discrepancies, allow results to fall within 1 percent of the specific range.

c. *Fluorimetric Analysis*

1. Verify that the instrument was calibrated daily and each time the instrument was set up using the correct number of standards and blanks.
2. Verify that the correlation coefficient is greater than or equal to 0.995

3. Recalculate one or more of the ICV and CCV %R using the following equation and verify that the recalculated value agrees with the laboratory reported values.

$$\%R = \frac{Found}{True} \quad x \quad 100$$

where,

Found is the concentration of each analyte measured in the analysis of the ICV or CCV

True is the concentration of each analyte in the ICV or CCV standard

Because of possible rounding discrepancies, allow results to fall within 1 percent of the specific range.

d. *Alpha Spectroscopy Analysis*

1. Verify that a daily performance check was completed for each detector.
2. Verify that the daily performance check was within the 3 σ error term on the control chart.
3. If the daily performance check was not within the 3 σ error term, then check that two additional counts were performed that were within the 2 σ error term for that day.
4. Verify that a daily background check was completed for each detector.
5. Verify that the daily background check was within the 3 σ error term on the control charts.
6. If the daily background check was not within the 3 σ error term, then check that two additional counts were performed that were within the 2 σ error term for that day.

e. *Gamma Spectroscopy Analysis*

1. Verify that a daily performance check was completed for each detector.
2. Verify that the daily performance check was within the 3 σ error term on the control chart.

3. If the daily performance check was not within the 3 σ error term, then check that two additional counts were performed that were within the 2 σ error term for that day.
4. Verify that a daily background check was completed for each detector.
5. Verify that the daily background check was within the 3 σ error term on the control charts.
6. If the daily background check was not within the 3 σ error term, then check that two additional counts were performed that were within the 2 σ error term for that day.

4.5.4 Action

a. *ICP-MS Analysis*

1. If the minimum number of standards were not used for initial calibration, or if the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable, R.
2. If the number of standards used is ≥ 3, and the calibration correlation coefficient is < 0.995, qualify results > IDL as J, and results < IDL as UJ. If the number of standards used is < 3, and the associated recoveries are < 90% or > 100%, or the RSD of a minimum of two replicate integrations is ≥ 5%, qualify results >IDL as estimated (J), and results < IDL as UJ.
3. If the ICV or CCV %R falls outside the acceptance windows, use professional judgment to qualify associated data. If possible, indicate the bias in the review.
4. If the frequency of the CCV does not meet contract specifications, qualify all associated data as J.

d. Atomic Absorption Analysis

1. If the minimum number of standards were not used for initial calibration, or if the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable, R.

2. If the correlation coefficient is less than 0.995, qualify results greater than the MDL as estimated (J), and results less than the MDL as estimated (UJ).
3. If the ICV or CCV percent recovery (%R) falls outside the acceptance windows, use professional judgment to qualify associated data. If possible, indicate the bias in the review.
4. If the frequency of the CCV does not met contract specifications, qualify all associated data as estimated (J).

c. *Fluorimetric Analysis*

1. If the minimum number of standards were not used for initial calibration, or if the instrument was not calibrated daily and each time the instrument was set up, qualify the data as unusable, R.
2. If the correlation coefficient is less than 0.995, qualify results greater than the MDL as estimated (J), and results less than the MDL as estimated (UJ).
3. If the ICV or CCV percent recovery (%R) falls outside the acceptance windows, use professional judgment to qualify associated data. If possible, indicate the bias in the review.
4. If the frequency of the CCV does not met contract specifications, qualify all associated data as estimated (J).

d. *Alpha Spectroscopy Analysis*

1. If a daily performance check was not conducted for the detector, or if the daily performance check was outside the 3σ error term on the control chart and two additional counts for that day were not within the 2 σ error term, qualify the data as R.
2. If a daily background check was not conducted for the detector, or if the daily background check was outside the 3σ error term on the control chart and two additional counts for that day were not within the 2 σ error term, qualify the data as R.

e. *Gamma Spectroscopy Analysis*

1. If a daily performance check was not conducted for the detector, or if the daily performance check was outside the 3σ error term on the control chart and two additional counts for that day were not within the 2 σ error term, qualify the data as R.
2. If a daily background check was not conducted for the detector, or if the daily background check was outside the 3σ error term on the control chart and two additional counts for that day were not within the 2 σ error term, qualify the data as R.

4.6 Laboratory Blanks

4.6.1 Objective - The objective of assessing laboratory blank results is to determine the existence and magnitude of analytical laboratory contamination. The criteria for evaluation of blanks apply to any blank associated with the samples. If problems with blanks exist, all data associated with the blank results must be carefully evaluated to determine whether or not there is an inherent bias in the data, or if the problem is an isolated occurrence.

4.6.2 Criteria - No contaminants should be in the calibration blank(s) and the number of calibration blanks reported in a data package should be at least 10% of the total number of samples reported. Preparation blanks should not exhibit contaminant concentrations > MDL and the number of preparation blanks reported in a data package should be at least 5% of the total number of samples reported.

4.6.3 Evaluation Procedure - Review the results for the blank(s) and verify that there were no laboratory contaminants detected and that the appropriate frequency of blanks was reported.

4.6.4 Action

1. Action in the case of detection of contaminants in the blank sample depends on the circumstances and origin of the blank. Professional judgment is required for the quality assessment of blank results.

Results greater than the MDL but less than 5 times the amount in any calibration blank should be qualified as U.

Note: The blank analyses may not involve the same weights, volumes, or dilution factors as the associated samples. The validator may find it easier to work from the raw data when applying 5 times criteria to soil sample data/calibration blank data. In instances where more than one blank is associated with a given sample, qualification should be based on a comparison with the associated blank having the highest concentration of a contaminant. The results should not be corrected by subtracting the blank value.

2. If the reported frequency of the calibration blanks when compared to reported samples is not greater than or equal to 10 percent, qualify the data as J.

   If the reported frequency of the preparation blanks when compared to reported samples is not ≥ 5%, qualify the data as J.

   If the reported preparation blank concentration is > MDL, all associated sample results < 10 times the preparation blank should be qualified with blank detection (B).

4.7 Laboratory Control Standard Analysis

4.7.1 Objective - The LCS analysis is designed to assess the efficiency of the digestion procedure.

4.7.2 Criteria - All LCS results must fall within the control limits specified in the project-specific sampling plan or the Contract Laboratory Technical Specifications.

4.7.3 Evaluation Procedure

1. Review the data and verify that the results fall within the control limits.
2. Check the raw data to verify the reported recoveries. Recalculate one or more of the %R using the following equation:

$$LCS\ \%R = \frac{LCS\ Found}{LCS\ True} \times 100$$

where,

LCS Found is the concentration of each analyte measured in the analysis of the LCS

LCS True is the concentration of each analyte in the LCS standard

4.7.4 Action

1. If the LCS recovery for any analyte falls outside the control limits, qualify the sample results greater than the MDL as J.
2. If the LCS results are higher than the control limits and the sample results are less than the MDL, the data are acceptable.
3. If the LCS results are lower than the control limits, qualify all sample results less than the MDL as UJ.
4. If LCS frequencies are less than 5 percent of the total number of reported samples, qualify the associated data as J.

4.8 Laboratory Duplicate Sample Analyses

4.8.1 Objective - The objective is to assess the precision of the sample results. Evaluation of the laboratory duplicate sample results assesses the precision of the instrumentation and analytical methods.

4.8.2 Criteria - The Relative Percent Difference (RPD) for metals and uranium and the Replicate Error Ratio (RER) for radionuclides must be within the specified sampling plan control limits for sample values greater than 5 times the CRDL.

4.8.3 Evaluation Procedure

1. Review and verify that results fall within the specified control limits.

2. Check the raw data and recalculate one or more RPD and RER using the following equations:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \, x \, 100$$

where,

RPD is the relative percent difference between duplicate results,
X_1 and X_2 are the results of duplicate analyses

$$RER = \frac{|S - R|}{\sqrt{TPU_s^{\,2} + TPU_R^{\,2}}}$$

where,

RER is the replicate error ratio
S is the sample value
TPU_s is the total propagated uncertainty for the sample
R is the duplicate value for the sample, and
TPU_R is the total propagated uncertainty for the replicate

4.8.4 Action - If duplicate analysis results for a particular analyte fall outside the appropriate control windows, qualify the results for that analyte in all samples associated with the duplicate analyses as J.

4.9 Field Duplicate Sample Analyses

4.9.1 Objective - Field duplicate samples may be taken and analyzed as an indication of overall precision. These analyses measure both field and laboratory precision; therefore, the results may have more variability than laboratory duplicates that measure only laboratory performance. It is also expected that soil duplicate results will have greater variance than those for samples obtained from other media, because of the relatively more heterogeneity in structure, composition, etc. of soils.

4.9.2 Criteria

1. The RPD for metals and uranium and the RER for radionuclides must be within the specified sampling plan control limits for sample values greater than 5 times the CRDL.
2. Field duplicate frequencies specified in project plans must be met.

4.9.3 Evaluation Procedure

1. Review and verify that results fall within the specified control limits.
2. Check the raw data and recalculate one or more RPD and RER using the following equations:

where,

RPD is the relative percent difference between duplicate results,
X_1 and X_2 are results of duplicate analyses

$$RER = \frac{|S - R|}{\sqrt{TPU_s^{\,2} + TPU_R^{\,2}}}$$

where,

RER is the replicate error ratio
S is the sample value
TPU_s is the total propagated uncertainty for the sample
R is the duplicate value for the sample, and
TPU_R is the total propagated uncertainty for the replicate

4.9.4 Action

1. If the field duplicate analysis results for a particular analyte fall outside the appropriate control windows, qualify the results for that analyte in all samples associated with the duplicate analyses as J.
2. If the frequency of field duplicates was not met, then use professional judgment to qualify the data. The validator should justify qualifiers assigned to the data based upon frequency criteria.

4.10 Matrix Spike Sample Analysis

4.10.1 Objective - The objective of assessing matrix spike sample analysis is to provide information about the effect of the sample matrix on the digestion and measurement methods.

4.10.2 Criteria - MDLs are specified in the associated work plan.

1. Spike recovery (%R) must be within the specified control limits. Note: Spike recovery limits do not apply when sample concentration exceeds the spike concentration by a factor of ≥4. In addition, spike recoveries are not performed for gamma spectroscopy analyses.
2. Matrix spike frequencies shall be greater than or equal to 5 percent of the total number of reported samples.

4.10.3 Evaluation Procedure

1. Review and verify that the results fall within the specified control limits.
2. Check raw data and recalculate one or more %R using the following equation to verify the reported results:

$$\%R = \frac{(SSR - SR)}{SA} x\ 100$$

where,

SSR is the spike sample result
SR is the sample result
SA is the spike added

3. If the resultant recovery is outside the control limits, new spike recovery control limits, considering the counting error for radionuclides at the 95 percent confidence level, are then calculated by:

$$\frac{SSR_{UL} - (SR + 1.96\sigma_{SR})}{SA}(100) = 125\%$$

and

$$\frac{SSR_{LL} - (SR - 1.96\sigma_{SR})}{SA}(100) = 75\%$$

By rearrangement:

$SSR_{UL} = 1.25\ (SA) + (SR + 1.96\ \square SR)$
$SSR_{LL} = 0.75\ (SA) + (SR - 1.96\ \square SR)$

where,

SSR_{UL} is the spiked sample result upper limit
SSR_{LL} is the spiked sample result lower limit
SA is the spike added
SR is the sample result
$1.96\sigma SR$ is the 1.96σ error of sample result.

4.10.4 Action

a. ICP, Fluorimetry, Radionuclides

1. If the spike recovery is greater than 125 percent and the reported sample results are less than the MDL, the data are acceptable.
2. If the spike recovery is greater than 125 percent or less than 75 percent and the reported sample levels are greater than the MDL, qualify the data for these samples as J, unless the 1.96σ is determined to be within control limits for radionuclides.
3. If the spike recovery falls within the range of 30-74 percent and the sample results are less than the MDL, qualify the data for these samples as UJ.
4. If spike recovery results fall less than 30 percent and the sample results are less than the MDL, qualify the data for these samples as R.
5. If the frequency of matrix spike samples is less than 5 percent of the total number of reported samples, qualify the associated data as J.

b. Furnace

1. If the furnace matrix spike recovery is less than 75 percent or greater than 125 percent, and the method of Standard Addition (MSA) is required and not performed, qualify the data for these samples as estimated (J).

2. If the furnace matrix spike recovery is less than 75 percent or greater than 125 percent, and the MSA, is not required, qualify the data for these samples as estimated (J).
3. If the frequency of matrix spike samples is less than 5 percent of the total number of reported samples, qualify the associated data as estimated (J).

4.11 Furnace Atomic Absorption QC Analysis

4.11.1 Objective - Furnace post-digestion spikes (also referred to as analytical spikes) assist in establishing the accuracy of the individual analytical measurements, and determine the need for the Method of Standard Additions (MSA).

4.11.2 Criteria - Post-digestion spike of a sample shall be injected immediately after that sample. The spike recovery (%R) must be within specified control limits. MSA must be performed, as required, the analyze additions must be at the appropriate concentration levels, and the MSA correlation coefficient must be ≥ 0.995.

4.11.3 Evaluation Procedure

1. Review and verify that post-digestion spikes have been performed as required and that recovery (%R) falls within control limits.
2. Check the raw date to verify that the MSA was conducted pursuant to requirements and that the correlation coefficient is ≥ 0.995.

4.11.4 Action

1. If the post digestion spike recovery is less than 85 percent or greater than 115 percent, analyze the sample by MSA.
2. If MSA is required but has not been done, qualify the data as estimated (J).
3. If any of the samples run by MSA have not been spiked at the appropriate levels, qualify the data as estimated (J).
4. If the MSA correlation coefficient is less than 0.995, qualify the data as estimated (J).

4.12 ICP Serial Dilution Analysis

4.12.1 Objective - The objective of assessing serial dilution analysis is to determine whether physical or chemical interferences exist due to sample matrix.

4.12.2 Criteria - If the analyte concentration is sufficiently high (concentration in the original sample is minimally a factor of 50 above the IDL), an analysis of a 5-fold dilution must agree within 10 percent difference (5%D) of the original results.

4.12.3 Evaluation Procedure

1. Check the raw data and recalculate the %D using the following equation to verify that the dilution analysis results agree with the reported results.

$$\%D = \frac{|I - S|}{I} x\ 100$$

where,

I is the initial sample result
S is the serial dilution result (instrument reading times 5)

2. Check the raw data for evidence of negative interference; e.g., results of the diluted sample are significantly higher than the original sample.

4.12.4 Action

1. When criteria are not met, qualify the associated data as J.
2. If evidence of negative interference is found, use professional judgment to qualify the data. The validator will document discrepancies and the justification for qualifying the data.

4.13 Assessment of Data Completeness

4.13.1 Objective - Completeness is a measure of the valid data obtained from the analytical measurement process as a comparison to the quantity of valid data planned for the project.

4.13.2 Criteria - The percentage of valid data (%C) must meet the criteria established in the project plans.

4.13.3 Evaluation Procedure

Calculate the percentage of valid data (%C) as follows:

$$\%C = \frac{V}{D} x\ 100$$

where,

%C is the percentage of valid data for each analytical parameter
V is the number of valid results for each analytical parameter
D is the number of samples submitted for analysis for each parameter

Note: With the exceptions of those assigned R qualifiers, all laboratory measurement results are valid.

4.13.4 Action - The validator must use professional judgment to determine the overall effect of the completeness of the data. The validator will provide discussion related to the overall completeness of the database for each project considered.

4.14 Sample Result Verification

4.14.1 Objective - The objective of sample result verification is to confirm the accuracy of reported results.

4.14.2 Criteria - Analyte quantitation must be calculated according to the associated work plan.

4.14.3 Evaluation Procedure

Examine approximately 5 percent of the raw data to verify the correct calculation of sample results reported by the laboratory. Compare digestion and distillation logs, instrument printouts, strip charts, etc. to the reported sample results.

1. Examine the raw data for anomalies; e.g., baseline shifts, negative absorbance, omissions, and legibility.

2. Verify that there are no transcription or reduction errors; e.g., dilutions, and sample weights.
3. Verify that results fall within the linear range for the ICP parameters and within the calibrated range for the non-ICP parameters.
4. Verify that sample results are greater than 5 times the ICP-MS MDL, if ICP-MS results are used for arsenic, thallium, selenium, or lead.

4.14.4 Action - If any discrepancies are found, the laboratory may be contacted by the PM or designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the validator may determine that qualification of the data is warranted.

5. OVERALL ASSESSMENT OF DATA FOR A CASE

It is appropriate for the data validator to make professional judgments and comments on the validity of the overall data for a case. This is particularly appropriate when several QC criteria used to assess validity are out of specification. The additive nature of QC criteria out of specification is difficult to assess in an objective manner, but must be done by the validator to inform the users of the quality and limitation of the data to avoid inappropriate use.

6. TRAINING

6.1 Not applicable.

7. RECORDS

7.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.3)

7.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

8. REFERENCES

8.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.3

9. ATTACHMENTS

Data Validation Worksheets.

Author's Signature:	Reviewed By:

ATTACHMENT 1

Data Validation Worksheets
Validation for Remedial Verifications and Risk Assessments

Soil Data Validation

Site_____ Project _____

Lab Job No._____ Sample ID's_____

Sample Date_____

Laboratory_____

Validation Date_____ Type_____

Method:_____

Criteria	OK	FYI	Action	Comments
Holding Times				
Chain-of Custody				
Detection Limits				
Calibration Blanks				
Initial Calibration				
Continuing Calibration				
Blanks				
Lab Control Sample				
Lab Duplicate				
Matrix Spike				
Other Pertinent Criteria:				
Criteria	**OK**	**FYI**	**Action**	**Comments**

Additional Comments _____

_____

_____

Signature:_____ Date:_____

STANDARD OPERATING PROCEDURE 5.11
SETUP AND OPERATION OF TRIMBLE PRO XRS RECEIVER WITH TRIMBLE TSCE DATALOGGER

1. PURPOSE

The purpose of the procedure is to instruct the user on how to properly setup a Trimble Pro XRS GPS unit to perform real time GPS gamma surveys using a Trimble TSCe datalogger and Ludlum 2221 ratemeter/scaler with RS-232 data output.

2. DISCUSSION

This SOP discusses the integration of a Trimble Pro XRS GPS unit, a Trimble TSCe datalogger, and a Ludlum 2221 ratemeter/scaler with RS-232 data output for use in conducting GPS radiological surveys. A data record is "logged" every time the 2221 outputs a data value to the TSCe through its RS-232 output. The GPS calculates its location every one second. The coordinate associated with each data value is interpolated between the locations calculated in the second before and after each data value is received. The TSCe records each data value as a "Not-In-Feature" record and associates the interpolated coordinate with the record. It is important the TSCe settings are correct to ensure the integrated components work together correctly.

3. PROCEDURE

3.1 Equipment

3.1.1 Trimble Pro XRS or XR GPS receiver.

3.1.1.1 When real-time data correction (dGPS) is necessary, a Pro XRS receiver and XRS antenna is necessary. Otherwise, the XR may be used.

3.1.2 Trimble Pro XRS or XR antenna. (see 3.1.1.1)

3.1.3 Trimble TSCe datalogger with stylus.

3.1.4 Charged batteries

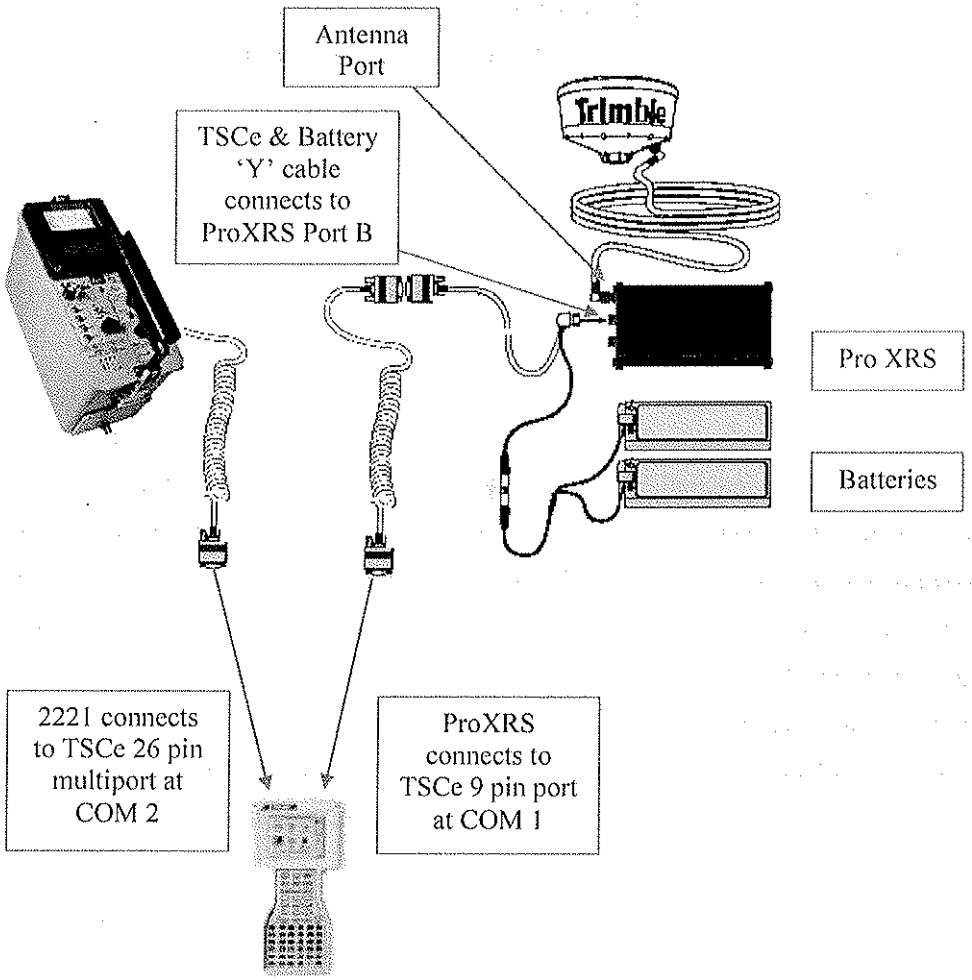
3.1.5 Ludlum 2221 scaler/ratemeter with RS-232 output

3.1.6 Ludlum 44-10 probe (or some other detector).

3.1.7 All necessary cables

3.2 Cabling Setup

3.2.1 Note: Refer to Figure below for an example of proper cable configuration associated with the GPS receiver, datalogger, and 2221 integration.



3.2.2 Connect the GPS receiver data/power 'Y' cable to port B of the Pro XRS receiver. Nothing connects to port A.

3.2.3 Connect the antenna cable to ANT port of the Pro XRS receiver.

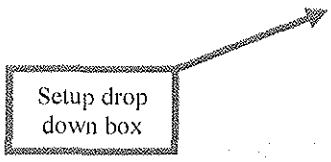
3.2.4 Connect the ProXRS receiver data output half of the data/power 'Y' cable to the TSCe COM1 port.

3.2.5 On the Ludlum 2221 connect the RS-232 data output cable to the TSCe COM2 port. You will have to use the DB9 to DB26 adaptor to connect to the TSCe COM2 port.

3.3 TSCe Setup

3.3.1 Turn on TSCe and open TerraSync. TerraSync is the Trimble application which communicates with the GPS receiver connected to TSCe, allowing you to set GPS parameters in the receiver, record GPS positions, and update existing GIS data.

3.3.2 From the opening window use the stylus and navigate to and tap the **'Setup'** drop down box in the upper left hand corner of the screen.



3.3.3 **Logging Settings**. Change the settings to the following:

Log Velocity Data:	No
Log SuperCorrect Data:	Yes
Log QA/QC Data:	No
Antenna Height:	2.000 m
Allow Position Update:	Yes
Confirm End Feature:	No
File name Prefix:	R
Style:	Time
Interval:	1s

3.3.4 You can change the setup option for the antenna by tapping the wrench icon next to Antenna Height. Change settings to the following:

Height: 2.000 m

Confirm: Never

Type: Unknown External

3.3.5 **GPS Settings**. Change the settings to the following:

GPS Receiver Port:	COM1
Slider Check Box:	√
Position on slider bar:	5 (mid-range) - This will result in a maximum PDOP of 6.0, a maximum

SNR of 4.0 and a minimum elevation of 15°.

Velocity Filter: Auto

3.3.6 **Real-time Settings**. Change the settings to the following:

Choice 1: Integrated Beacon

Choice 2: Integrated WAAS

Choice 3: Use Uncorrected GPS. With this third option you will download base station data and post process receiver data after survey if necessary.

Real-time Age Limit: Leave at default value of 50 seconds

3.3.7 **Coordinate System**. Change the settings to correct coordinate system

3.3.8 **Units**. Change the units to the desired units of measure

3.3.9 **External Sensors**. Check the Sensor 1 check box and then tap Properties. Change settings to the following:

Name: Ludlum 2221

Port: COM2

Baud Rate: 9600

Data Bits: 8

Stop Bits: 1

Parity: None

Prefix: R

Suffix: \0D\0A

Max Bytes: None

Time Out: 0.10s

Receive Mode: Unsolicited

Request String: None

Point Feature: All

Line/Area Feature: All

Not In Feature: All

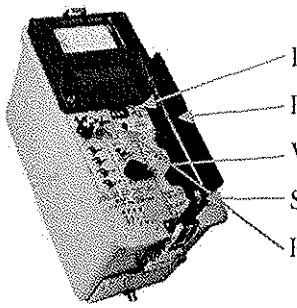
Data Destination: Uninterpreted

Attribute Name: (not displayed)

3.4 Ludlum 2221 Setup

3.4.1 Secure the RS-232 cable to 2221 handle. NOTE: The RS-232 cable is not very durable at the point where the wire housing and the metallic elbow meet. You need to tape/secure the cable to the handle to prevent premature cable shorting from causing problems with the survey data

3.4.2 Set the following 2221 switches to the following positions:



Power: ON

RESP: F

WIN: OUT

SCALER/DIG RATE:DIG. RATE

RS-232 Port

3.5 Operation

3.5.1 Opening a New File

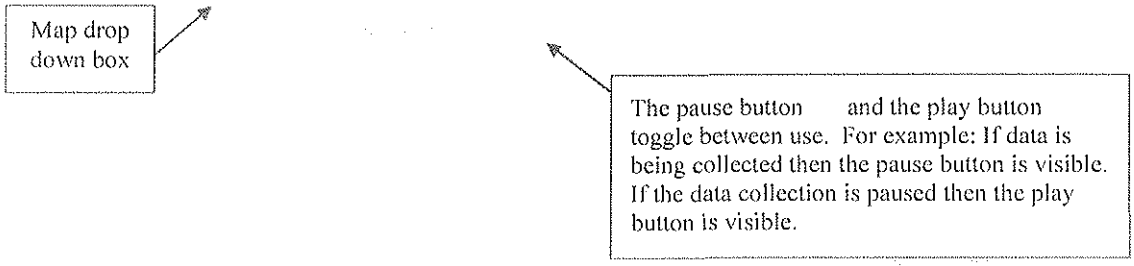
3.5.1.1 From the opening window use the stylus and navigate to and tap the Data drop down box. Tap the Create button to create a new file.

3.5.1.2 To open an existing file navigate to and tap the Existing File subsection list drop down box. Select the desired file and tap on the Open button in the upper right hand corner of the screen.

3.5.1.3 NOTE: Data collection will begin when a file is opened if TSCe and 2221 parameters are all set correctly and enough satellites are visible.

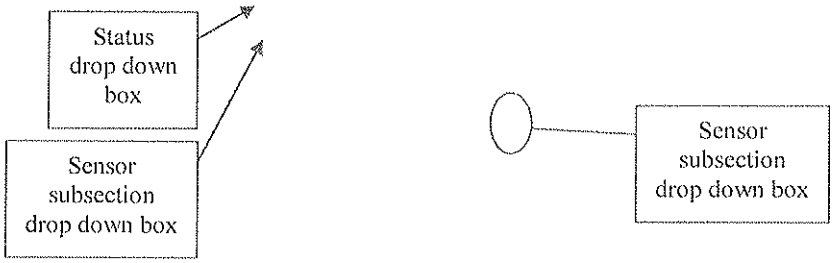
3.5.2 Pausing Data Collection

3.5.2.1 To pause data collection, navigate to the Map drop down box and tap on the pause button. To resume data collection, tap the play button.



3.5.3 Viewing Data Collection

3.5.3.1 It is advised to view data collection at the beginning of each survey to ensure all setup parameters have been set correctly and system is correctly collecting data.



3.5.3.2 To view data collection, navigate to the Status drop down box and then the Sensor subsection drop down box. The Total Count line indicates the number of gamma counts collected. The Last String line indicates the last gamma count recorded.

3.5.4 Closing Data Collection File

3.5.4.1 There are two ways to stop and close a data file. You can close the TerraSync application completely, or you can close the individual survey file and leave the TerrSync application running.

3.5.4.1.1 To close the TerraSync application completely, tap the in the upper right hand corner.

3.5.4.1.2 To close only the survey file, navigate to and tap the Data drop down box and then tap the Close button.

3.5.4.2 **Note**: If the TSCe is shut off without closing the file and closing TerraSync, the data collection file could be corrupted. If the TSCe battery is running low,

the user should perform the above steps to save and close the file and charge the TSCe so as to prevent data corruption.

3.6 Useful Information - Below are some useful tips picked up along the way. It is advised the operator read this section as you'll likely encounter some of these situations during a survey.

3.6.1 Tape your camcorder battery clips to the camcorder batteries. They'll come off during a survey if you don't

3.6.2 Do not start a survey file unless you are in the survey area and your 2221 is turned on. You may collect erroneously low gamma counts if you wait to turn your 2221 on after you start a survey file

3.6.3 If you do not see any gamma counts being collected make sure that A) the 2221 is turned on, and B) the 2221 is in the DIG. RATE mode.

3.6.4 If you acquire no satellites after waiting one minute check antenna cabling or make sure you have connected through the TSCe Setup screen

4. TRAINING

4.1 Prior to use in the field, all personnel must show proficiency in the operation the GPS and associated Ludlum hardware.

4.2 Prior to use in the field, all personnel must show proficiency in use the Trimble software.

4.3 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.2 above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 None.

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 5.12
DOWNLOAD, CORRECTION, AND EXPORT OF GPS SURVEY DATA

1. PURPOSE

The purpose of this procedure s to instruct the user on how to: (1) properly download survey data from a Trimble TSCe datalogger, (2) differentially correct the survey data by post process method, and (3) export the survey data into an ArcMap shapefile format for use in ESRI ArcMap GIS

2. DISCUSSION

After GPS data has been collected the data must be transferred from the datalogger to a computer running the Trimble Pathfinder Office (PFO) application. PFO will be necessary for downloading, exporting, and correction of all survey files. Once downloaded the survey data can be differentially corrected, if need be, and exported into a file format usable by the ESRI ArcView GIS application known as a shapefile. In most cases the survey data will be collected with the differential correction applied in "real time" (as the data is collected) and the correction step will not be necessary. If the survey is performed in a location where "real time" collection is not possible then this step will be necessary.

It is important to create the necessary directories in Windows Explorer before beginning a project. This will help keep data organized through the entire GPS survey project process. Further information regarding directory organization is discussed in SOP 5.01

3. PROCEDURE

3.1 Creating a New Project or Opening an Existing Project

3.1.1 NOTE: When creating a new project, it is necessary to also create a new project folder with subfolders to keep all of the files properly organized. As projects get larger they become very complicated.

3.1.2 In Windows Explorer navigate to the project directory folder and create the following folders in the following folder structure. The raw survey files (.ssf file format) will be kept in the GPS folder directly. There is no need for a subfolder because each survey file will have its own unique name based on the survey date and time. If using more than one GPS unit in a survey you should change the name of the survey files to reflect so. As an example you might change the first GPS unit

file name to end in the letter A and change the second GPS unit file name to end in a B, and so on.

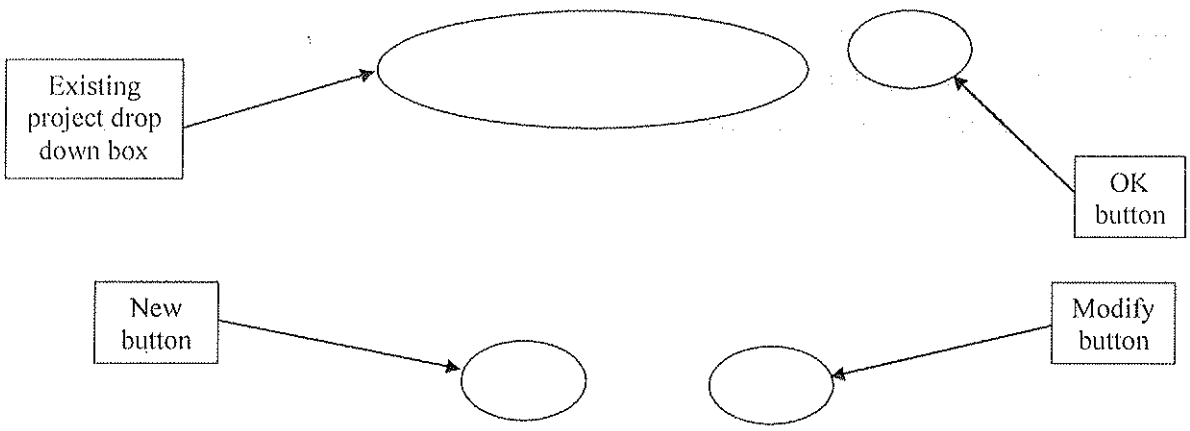
3.1.3 Under the Export subdirectory a folder for each day that a survey is performed and exported will be created. Five files will be created when the export utility is used (dbf., shx., shp., txt., and a setup information file)

3.2 Creating New PFO Project

3.2.1 Open the PFO application by locating and double clicking on the icon on the computer desktop or in the GPS Pathfinder Office folder

3.2.2 If the Select Project window does not appear when the application is started then open the **File** menu and select the **Projects** option. A new window will appear in the office window titled Select Project shown below.

3.2.3 If you are creating a new project select the New button. If you are working in an existing project then using the drop down box choose the correct project and select the OK button.



3.2.4 Select the modify button and set the correct locations for the Project folder, Backup Files, Export Files, and Base files

3.2.5 It is necessary to choose the project coordinate system when beginning a project. Open the **Options** menu and select **Coordinate System**. Using the drop down boxes select the correct coordinate system. The standard datum and units for that system will be chosen automatically but you can change them if necessary.

3.3 Download of Survey Data

3.3.1 Connect TSCe to computer running PFO using the 26-pin multiport adaptor

3.3.1.1 Attach the 26-pin multiport adaptor end to the TSCe. Connect the USB cable to the computer running PFO. Turn on TSCe

3.3.1.2 A Microsoft ActiveSync window will open up and ask about setting up a new partnership. The correct answer is No, do not synchronize data. Set up the device as a guest

3.3.1.3 If ActiveSync doesn't open up immediately then unplug USB cable and reattach. If still no connection then refer to the TerraSync Users Manual Troubleshooting section

3.3.2 Open the PFO application and select the correct project to open

3.3.3 Open the Data Transfer utility by locating and selecting the icon or from the **Utilities** menu select the **Data Transfer** option.

3.3.4 Make sure the device is set to 'GIS Datalogger on Windows CE' and select the connect button. When connected select the Add button and choose the desired files to transfer from the TSCe to the computer running PFO. Select the Transfer All button.

3.3.5 Survey data should now be transferred to the folder chosen in Project Setup

3.4 Correction of Survey Data

3.4.1 Most survey data collected will be collected in "real time", meaning the data is differentially corrected as it is collected. If this is the case then you will not need to correct the data again. You will know the data is collected in "real time" if you see a satellite image on the TSCe screen while collecting data. The following figures are examples of images you will see on the TSCe screen indicating "real time" corrections are taking place:

DGPS Beacon Service:

DGPS Subscription Service (OmniStar):

WAAS Correction:

3.4.2 Open the Differential Correction utility in PFO by locating and selecting the icon or from the **Utilities** menu select the **Differential Correction** option.

3.4.3 If correcting only one file then the last file downloaded using the Data Transfer utility should appear in the 'Rover Files: Selected Files' field as default. If multiple rover files need to be corrected then select the browse button, navigate to and select the uncorrected files.

3.4.4 Specify the location of the base files. Depending on the source of the base files, there are three options: Local Search for base files, Internet Search for base files, or

Browse. The typical base file will be downloaded from the internet. Choose Internet Search.

3.4.5 Choose the necessary base station location from the Base Data Provider drop down box and select the OK button. The closest base station to the survey location should be chosen. After the base station data has been downloaded it will appear in the 'Base Files: Selected Files' field by default.

3.4.6 The Corrected Files: Output Folder field should default to the GPS project folder where the survey files have been downloaded to. If another folder is to be used for the corrected file storage then select the browse button and navigate to that location.

3.4.7 Select the OK button in the upper right corner of the Differential Correction window to complete the correction process. The chosen rover file(s) will be corrected using the chosen base file(s) and saved to the chosen output folder

3.5 Exporting survey data into shapefile format

3.5.1 Open the Export utility in PFO by locating and selecting the  icon or from the **Utilities** menu select the **Export** option

3.5.2 If exporting only one file then the last file downloaded using the Data Transfer utility should appear in the 'Input Files: Selected Files' field as default. If that file was differentially corrected then the corrected file will be the default file to export. If multiple files are to be exported then select the browse button and navigate to and select the desired files

3.5.3 The project export folder should be the default for the Output Folder field. The export files are all named the same during the export process so a subfolder is needed. At the end of the output folder field add the date in MMDDYY format. Example: C:\ERG\Project\ GPS\Export\MMDDYY.

3.5.4 Select 'Sample ESRI Shapefile' Setup from the 'Choose an Export Setup' drop down box.

3.5.5 The coordinate system the files will be exported in is the same as the project coordinate system set in step 3.1.2.5 above. If this needs to be changed it should be done so before exporting

3.5.6 Select the Properties button and change the following parameters.

3.5.6.1 Data tab:

3.5.6.1.1 Type of Data to Export choose the 'Features - Positions and Attributes' and from the drop down box select 'Export All Features'

3.5.6.1.2 Create Point Features From: check the box for 'Sensor Records'

3.5.6.2 Attributes tab:

3.5.6.2.1 Under General Attributes – All Feature Types check the boxes for 'Date Recorded' and 'Time Recorded'

3.5.6.3 Position Filter tab:

3.5.6.3.1 Select the 'Filter by GPS Position Info' option

3.5.6.3.2 Uncheck the boxes for 'Include Positions That Are – Uncorrected' and 'Include Non-GPS Positions'.

3.5.6.4 Coordinate System tab:

3.5.6.4.1 Select the 'Use Current Display Coordinate System' and choose the 'export coordinate as: XY'. If you choose XYZ and do not have Spatial Analyst installed on ArcView GIS you will not be able to edit the data

3.5.6.4.2 NOTE: If you choose XYZ (point Z) you will not be able to merge data with XY (point) data. If you choose XY you will not be able to merge data with XYZ. It is therefore important to be consistent in this regard.

3.5.7 Select the OK button in the upper right corner of the Export window to complete the export process. The chosen rover file(s) will be exported into the chosen format and saved to the chosen output folder

3.6 Converting String Data Into Number Data

3.6.1 With the ArcMap software and the shapefile added, open the attribute table

3.6.2 Select 'Add New Field…' under the **Options** menu.

3.6.2.1 Title the new field 'Gamma' and select the type to be long (integer).

3.6.2.2 Right click on the new field 'Gamma' and select 'Field Calculator.'

3.6.2.3 In the window below **[Gamma]** = type in (or select) **[Text]**.

3.6.2.4 NOTE: Some times the string data will not convert into number data. If there are any characters other than numbers there will be an error because non numeral string data (any character other than the numbers 0 – 9) can not be converted into numbers. You will have to scan through and remove these data records before the entire data set can be converted. This tends to happen when there is a poor RS-232 connection due to a loose connection or bad cable

4. TRAINING

4.1 There is no specific training pertinent to this SOP.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

7. ATTACHMENTS

7.1 None

Author's Signature:	Reviewed By:

STANDARD OPERATING PROCEDURE 5.13
PERFORMING GPS RADIOLOGICAL SURVEYS BY VEHICLE

1. PURPOSE

To describe the daily task for the radiological surveying with and operation of the site survey vehicle.

2. DISCUSSION

Oftentimes the scale of radiological surveys needed make their completion on foot difficult. Where site conditions allow it, completion of such surveys by vehicle are a possible alternative. The decision to utilize vehicle based surveys (as opposed to other survey methods) will typically be make by the project management team prior to deployment in the field.

3. PROCEDURE

3.1 Equipment

3.1.1 Typical GPS Radiological Survey Setup (see SOP 5.11)

3.1.1.1 It is possible to operate multiple GPS setups on a single vehicle. In this case, the equipment should be complete for each individual setup.

3.1.2 12' C-C cable (to replace curly-C cable)

3.1.3 Extended antenna cable (to replace standard antenna cable)

3.1.4 Site vehicle equipped with detector bracket(s)

3.2 Operation

3.2.1 To achieve proper data coverage drive vehicle at a speed similar to a fast paced walk. This is can be accomplished by allowing vehicle to idle along in 4WD-Low or "granny gear". Note that driving a four-wheel drive vehicle with the front differential engaged (i.e., in four-wheel drive) while on hard surfaces such as gravel or pavement will cause changes in the way the vehicle handles. Specifically, it may become more difficult to steer and maneuver the vehicle.

3.2.2 Have someone walk at 9 feet to side of vehicle and place pin flags or spray paint on ground at intervals easily seen by driver. When vehicle makes next pass by, driver should attempt to pass probe over marked line. This allows data to be taken in consistent pattern

3.2.3 Proper planning will allow for an area to be completely surveyed within a given time. It is less desirable to start a large section on one day and finish on another

4. TRAINING

4.1 Prior to use in the field, all personnel must show proficiency in the operation the associated GPS and radiological monitoring equipment.

4.2 Prior to use in the field, all personnel must demonstrate the knowledge of safe vehicle operation.

4.3 Prior to personnel being assigned to the field, supervisor must sign off of the Training Qualifications Form that he/she met requirements 4.1-4.2above.

5. RECORDS

5.1 Records of the completed work, measurements, calculations, and data must be preserved, protected, and retained according to the contract and/or ERG's record retention process (see SOP 4.03)

5.2 Computer generated files will be saved as print and electronic files and stored with field notebooks.

6. REFERENCES

6.1 Project personnel using this procedure should become familiar with the contents of the following documents:

SOP 4.03

Form 4.00 Training Qualification Form

7. ATTACHMENTS

7.1 None.

Author's Signature:	**Reviewed By:**

Appendix C

Site-Specific Health and Safety Plan

HECLA MINING, INC

Health and Safety Plan for the Site Assessment of Johnny M Mine and Associated Properties

May 2012

Prepared by:

Environmental Restoration Group, Inc.
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Albuquerque, NM 87113
505-298-4224

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LIST OF ACRONYMS

α	alpha
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
°C	Degrees Celsius
CFR	*Code of Federal Regulations*
COC	constituents of concern
CPR	Cardiopulmonary Resuscitation
CRZ	Contamination Reduction Zone
DAC	Derived Air Concentration
dBA	decibels (A-weighted)
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EPA	(U.S.) Environmental Protection Agency
ERG	Environmental Restoration Group, Inc.
EZ	exclusion zone
°F	degrees Farenheit
FM	field manager
ft	foot/feet
GPS	global positioning system
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCS	Hazard Communication Standard
HECLA	Hecla Mining, Inc.
HEPA	high efficiency particulate air
HPIC	high pressure ionization chamber
HPS	Hantavirus pulmonary syndrome
JSA	job safety analysis
kV	kilovolt
m^2	square meter
mg/m^3	milligrams per cubic meter
mph	miles per hour
mrem	millirem
MSDS	Material Safety Data Sheet
NRR	noise reduction ratio
OSHA	Occupational Safety and Health Administration
PM	project manager
PPE	personal protective equipment
SAP	site assessment plan
SOP	standard operating procedures
SSO	site safety officer
SZ	support zone

1.0 INTRODUCTION

1.1 Scope and Applicability of the Site Health and Safety Plan

This Health and Safety Plan (HASP) establishes the responsibilities, requirements, and procedures for the protection of Environmental Restoration Group, Inc. (ERG) and subcontractor field personnel performing work at the Johnny M Mine and adjacent properties (the Site) for Hecla Mining, Inc. (Hecla). "Field personnel" is defined herein as ERG and its subcontractor employees. The purpose of this plan is to provide a framework for a safe working environment during field activities. The appropriate safety organization, procedures, and protective equipment are based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methods are selected to minimize the potential of injury, illness, or other hazardous incident.

This HASP applies to the scope of work for the site assessment described in the *Site Assessment Plan for the Johnny M Mine* (ERG, 2012). Recent investigations conducted by the U.S. Environmental Protection Agency (EPA) indicate that mine-related material from the Johnny M Mine has migrated onto adjacent property. The contaminants of concern at the Site are the natural uranium series radionuclides and heavy metals.

Previous radiological surveys conducted at the Site indicate general exposure rates expected at the Site. The highest exposure rates occur on and around the rock pile in Area A; and the home and corral in Area C. The pending radiological survey and accompanying exposure rate correlation will provide updated, accurate site-wide exposure rates.

The Occupational Safety and Health Administration (OSHA) requires employers and employees involved in CERCLA investigation and clean-up activities to comply with 29 *Code of Federal Regulations* §1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), which refers to 29 *Code of Federal Regulations* (CFR) §1910 and §1926 as applicable standards. This HASP has been designed to meet OSHA standards, which are applicable in the State of New Mexico, and follows the general outline presented in 9285.1-03/PB92–963414, *Standard*

Operating Safety Guides (EPA, 1992). New Mexico is a "State Plan" State, and has largely adopted the OSHA regulations.

> **Except in emergency situations, no deviations from this plan may be implemented without the prior notification and approval of the ERG Project Manager (PM). This HASP will be re-evaluated if there are changes in site conditions or the scope of work; or updates are warranted.**

This HASP addresses site-specific safety and health issues, including a Site description and contaminant characterization; safety and health risk or hazard analysis for each task (including chemical, physical, and biological hazards), monitoring requirements; action levels for upgrading personal protective equipment (PPE) or evacuating the Site, and emergency assistance information. The HASP provides a framework to develop a generalized Job Safety Analysis (JSA), which provides 1) a description of the steps and equipment needed to provide our services and 2) identifies the potential health and safety hazards and the controls that will be implemented. The JSAs will be kept in a separate file at the Site. The content of the JSAs will be communicated to all field personnel.

The ERG Field Manager/Site Safety Officer (FM/SSO) is the onsite person responsible for the safety of all members of the ERG field team and responsible for implementing this safety plan onsite. The PM has the authority to remove from the Site any field personnel who refuses to comply with this plan, or whose behavior endangers their own or other people's safety. The health and safety coordinator for the project is also the PM.

1.2 Site Description and Overview of Tasks

This section presents a general description of the Johnny M Mine and associated properties, background, and regional physical setting. It also includes a brief description of the field tasks.

1.2.1 Site Description and History

The Johnny M Mine (also referred to as "Area A" in the SAP [ERG, 2012]) is located on private rangeland in the Ambrosia Lake district in McKinley County, New Mexico, approximately one mile north of New Mexico Highway 605 and 5 miles northwest of the village of San Mateo, New Mexico as shown in Figure 1. The Site includes Area A and the properties:

- West of Area A within the western half of Section 18 (hereinafter "Area C")
- Within both the eastern half of Section 18 and the southern half of Section 7 (hereinafter "Area B"), and any drainage pathways to the west of Area C.

Areas A, B and C lie within Township 13 North, Range 8 West (T13N, R8W) including areas within Section 18, and the southeast quarter of Section 7. Figure 2 depicts Areas A, B, and C.

The development of Johnny M Mine began in 1973, with the first ore produced late in 1976. The last ore production at the mine occurred early in 1982. All ore was shipped offsite for milling and recovery of uranium. Uranium mill tailings were brought onto the mine for use as underground structural support material (backfill as part of the mining operation.

The mine is no longer active and most of the buildings have been removed. There is an empty, former residence and corral on Area C. Site access is restricted by a horse fence and locked gate.

Climate in the area is characterized by low precipitation, high evaporation, abundant sunshine, low relative humidity, moderate temperature and infrequent incidences of severe weather. The maximum yearly precipitation occurs during the summer thundershower season, when four to five inches of precipitation is normal. This is 40-50% of the average annual precipitation of about ten inches.

Average monthly temperatures range from about 30 degrees Fahrenheit (°F) in January to the mid-70s in July, with a minimum and maximum of less than 0 to greater than 100 °F. Relative humidity of the area is highest at sunrise (65 percent) and lowest in mid-afternoon (about 30 percent) in mid-afternoon. Gross annual lake evaporation is 50-60 inches per year.

There are no perennial water bodies at or within 5 kilometers the Site; however there are several intermittent streams. Two of these are both located approximately 3.5 kilometers to the south (San Mateo Creek) and east (Rafael Canyon Creek). Surface runoff can be expected to occur during periods of intense precipitation, most likely in summer. Typically, water runoff quickly evaporates and/or percolates into local soils. Arroyos are present at the Site.

1.2.2 Overview of Tasks

The tasks of the site assessment, as described in the SAP (ERG, 2012), are:

- Performing a Global Positioning System (GPS)-based gamma survey;
- Collecting High Pressure Ionization Chamber (HPIC) and co-located integrated gamma measurements;
- Performing a geomorphological survey;
- Collecting static bare and shielded gamma detector measurements in the mine area;
- Advancing soil borings to depths exceeding the base of contamination;
- Installing trenches to depths exceeding the base of contamination, if warranted;
- Conducting downhole gamma logging the soil borings;
- Installing a sediment control barrier; and
- Collecting soil samples.

2.0 ROLES AND RESPONSIBILITIES OF KEY PERSONNEL

This section presents the roles and responsibilities of the key personnel involved with health and safety for Site activities.

2.1 All Personnel

All ERG personnel and subcontractors will adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner conflicting with these procedures. After due warnings, the PM may dismiss from the site any person who violates safety procedures.

All ERG personnel and subcontractors will have received training in accordance with applicable regulations prior to the start of field activities. Field personnel will read and acknowledge their understanding of this HASP before the work starts, and abide by the requirements of the HASP. All onsite personnel will sign the HASP Acknowledgement Form after reviewing this HASP. Finally, all personnel will attend an initial hazard briefing prior to the start of field work.

2.2 Health and Safety Officer

The PM/HSO or his/her designee has the overall responsibility for the technical health and safety aspects of the project, including the review and approval of this HASP. Inquiries regarding ERG health and safety procedures, project procedures, and other technical or regulatory issues will be addressed to this individual. The PM/HSO or his/her designee will approve changes or addenda to this HASP.

2.3 Project Manager

The PM is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the field manager has the

equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP. It is also the responsibility of the PM to perform the following:

- Consult with the HSO on Site health and safety issues.
- Verify that subcontractors meet health and safety requirements prior to commencing work.
- Verify that all incidents are thoroughly investigated.
- Approve, in writing, addenda or modifications to this HASP.
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.4 Field Manager/Site Safety Officer

The FM/SSO is responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues will be addressed to this individual. The FM/SSO will advise the PM on health and safety issues.

The FM/SSO will inform the PM daily of the activities planned, progress of the work, and the number of field personnel onsite.

The FM/SSO is the primary Site contact on health and safety matters. It is the responsibility of the FM/SSO to perform the following duties:

- Provide onsite technical assistance, if necessary.
- Coordinate dust monitoring and personnel/equipment scanning for radiological contamination, as required, including equipment maintenance and calibration.
- Conduct safety orientation, training, and meetings.
- Verify that ERG and subcontractor personnel have received required training and certifications.
- Review Site activities with respect to compliance with this HASP.

- Maintain required health and safety documents and records.
- Instruct field personnel on project hazards and protective procedures.
- Provide onsite technical assistance regarding radiological compliance;
- Manage radiological instrumentation equipment maintenance and calibration.
- Maintain all records related to radiological health and safety.
- Consult with the HSO on Site health and safety issues.
- Notify the PM of any incidents.
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance.
- Obtain a Site map, determine and post routes to medical facilities, and post emergency telephone numbers.
- Observe field personnel for signs of ill-health effects.
- Investigate and report any incidents to the HSO.
- Verify that all field personnel have completed applicable training.
- Verify that field personnel are informed of the physical, chemical, and biological hazards associated with the Site activities and the procedures and protective equipment necessary to control the hazards.

2.5 Field Personnel

Field personnel will follow the requirements and guidance described in this HASP.
Field personnel will immediately report the following to the FM/SSO:

- Personal injuries and illnesses, no matter how minor.
- Unexpected or uncontrolled release of chemical substances.
- Symptoms of chemical exposure.
- Observations of radiological contamination on clothing or skin.
- Unsafe or hazardous situations.
- Unsafe or malfunctioning equipment.
- Changes in Site conditions that may affect the health and safety of project personnel.

- Damage to equipment or property.
- Situations or activities for which they are not properly trained.
- Near misses.

2.6 Subcontractors

Subcontractors and their personnel will understand and comply with applicable regulations and Site requirements established in this HASP. Subcontractors may prepare their own site-specific HASP that will be consistent with the requirements of this HASP. Alternatively, subcontractors may adopt this site-specific HASP. ERG will provide a copy of the HASP to subcontractor for its review. The subcontractor may then complete the ERG HASP Memorandum of Acknowledgement.

All subcontractor personnel will have received training in accordance with applicable regulations and be familiar with the requirements and procedures contained in this HASP, prior to the start of field activities. All subcontractor personnel will attend an initial hazard briefing prior to the start of field activities. In addition, ERG and onsite subcontractor personnel will attend and participate in the daily Site safety meetings.

2.7 Visitors

All visitors are expected to check in with the FM/SSO, who will provide a safety orientation prior to yielding access to the Site. Visitors will provide all required documentation demonstrating that they have the required, applicable training. Visitors will not be allowed access to any portion of the Site without escort by field personnel. Visitors will be cautioned to avoid skin contact with surfaces, soils, or other materials that may be impacted by Site constituents of concern (COCs).

Visitors will don appropriate PPE prior to entry to the work area and will have the appropriate training and medical clearances to do so.

2.8 Stop Work Authority

Every ERG employee and subcontractors is empowered, expected and has the responsibility to stop the work of another co-worker if the working conditions or behaviors are considered unsafe. No repercussions will result from this action.

Site or project conditions that are possible reasons to stop work and to consider modifications to the HASP include:

- Site temperatures outside the range predicted in this HASP (possibly resulting in greater risk of heat or cold stress).
- PPE breakthrough or unexpected degradation.
- Unusual odors that cannot be identified.
- Unexplained, elevated readings on an organic vapor monitor.
- Unexpected changes in soil coloration or texture that might indicate undisclosed contamination.

This list is not comprehensive and will be used only as guidance.

3.0 TASK SAFETY AND HEALTH HAZARDS AND MITIGATION

3.1 Scope of Work

General work activities at the Site are expected to include the following:

- Mobilization and Demobilization
- Radiological surveys
- Drilling and trenching
- Field sampling and downhole logging
- Construction of sediment control structures.

The geomorphological survey is not discussed further, because it is largely involves walking and some climbing, a task which is addressed in radiological surveys.

3.2 Job Safety Analysis

Job Safety Analysis (JSA) is an integral part of the HASP. This process is the collective analysis of the hazards identified for each field task. It is comprised of individual JSAs for each task, detailed in tabular form. JSAs will be kept on file during the field activities and amended, as necessary, to address new hazards encountered during field activities, or when control measures are changed to more effectively reduce potential risks associated with worksite activities.

The JSAs will identify potential health, safety, and environmental hazards associated with the field activities listed in Section 3.1. Because of the complex and changing nature of field projects, supervisors will continually inspect the Site to identify hazards that may affect onsite personnel, the community, or the environment. The FM/SSO will be aware of these changing conditions and discuss them with the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The FM/SSO will keep field personnel informed of the changing conditions and the PM will write and/or approve addenda or revisions to this HASP as necessary.

3.2.1 General Introduction to Chemical and Radiological Hazards

Mine-related materials (waste rock and contaminated soils) at the Site may contain elevated levels of heavy metals, including arsenic, barium, molybdenum, selenium, and vanadium. The materials may also contain elevated levels of uranium series radionuclides, which include radium-226 and radon-222. These radionuclides can pose direct and indirect ionizing radiation hazards. Direct hazards are due to gamma and/or x-rays. Indirect hazards are posed by inhalation, ingestion, or injection of the radioactive materials into the body. Table 3-1 lists the potential routes of exposure posed by the heavy metals and radionuclides.

Table 3-1. Potential routes of exposure posed by Site constituents of concern

Heavy Metal, Radionuclide	Potential Routes of Exposure
Arsenic	Inhalation, ingestion, skin absorption
Barium	Inhalation, ingestion
Lead	Inhalation, ingestion, skin absorption
Molybdenum	Inhalation, ingestion, skin absorption
Selenium	Inhalation, ingestion, skin absorption
Vanadium	Inhalation, ingestion
Radium	Inhalation, ingestion, direct
Uranium	Inhalation, ingestion

Note: The controls for chemical and radiological hazards are largely similar, given that both the chemicals and radionuclides are heavy metals, in particulate form. An exception to this is radon-222, which is an inert gas. Exposure to chemical and radiological hazards will be minimized by way of using proper PPE and minimizing the generation of dust.

ERG personnel and/or its subcontractors also may be tasked with handling hazardous chemicals during the course of work at the Site. The list of potential hazardous chemicals includes spray paint and hydraulic fluids and/or fuels associated with vehicles, the drill rig(s), or heavy equipment.

4.0 GENERAL SAFETY PRACTICES

While on the Site, all ERG field personnel are to become familiar with and obey the rules, safety standards and requests described in the following sections.

4.1 Buddy System

Use of the "buddy system" is required during all operations. Personnel will observe each other for signs of heat or cold stress and chemical exposure. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin coloration.
- Changes in coordination.
- Changes in demeanor.
- Excessive salivation and pupillary response.
- Changes in speech pattern.

Personnel will also be aware of the potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures.

Field personnel will inform their colleagues of nonvisible effects of exposure to toxic materials that they may be experiencing. The symptoms of such exposure may include, but are not limited to:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory tract

If protective equipment or noise levels impair communications, pre-arranged hand signals will be used for communication. Personnel will stay within line of sight of another team member.

4.2 Work Zones

The ERG FM/SSO will establish the work zones described below. In addition, decontamination procedures are prescribed for intrusive work. No entry/exit log is required, given the brevity of the field tasks described herein. Work zones will be established only for intrusive work involving drill rigs or backhoes to minimize potential exposures to dust. Work zones will not be established for other tasks.

4.2.1 Exclusion Zone

An exclusion zone (EZ) is established to prevent the spread of contamination and unauthorized people from entering hazardous areas. All employees entering an EZ will use the required PPE, and will have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. Cones or caution tape will identify the location of each EZ.

4.2.2 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is a transition area between the EZ and support zone. Decontamination of personnel and equipment will be conducted in the CRZ, if warranted. This zone is the only appropriate corridor between the EZ and the SZ.

4.2.3 Support Zone

The Support Zone (SZ) is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the SZ only after proper decontamination. Smoking may be permitted in the SZ, subject to Site requirements.

4.2.4 Authorization to Enter

Only personnel with the appropriate training will be allowed to work at the Site. The FM/SSO will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed to enter the Site work areas.

4.2.5 Site Orientation and Hazard Briefing

No one will be allowed in the work area during Site operations without first being given a Site orientation and hazard briefing. The orientation and briefing, consisting of a review of this HASP, will be presented by the field manager. The review will cover the physical, biological, and chemical hazards; PPE; safe work procedures; and emergency procedures for the project. Following this initial meeting, daily safety meetings will be held each day before work begins.

The FM/SSO will document attendance at the briefing.

4.2.6 Certification Documents

A training file will be established for the project and kept on Site during all Site operations. All ERG and subcontractor personnel will provide their training certificates to the ERG HSO prior to starting work.

4.2.7 Entry Requirements

In addition to the authorization, hazard briefing, and certification requirements listed above, no person will be allowed in any work area unless they are wearing the minimum PPE as described in Section 6.0, Personal Protective Equipment.

4.2.8 Emergency Entry and Exit

Personnel who will enter the work area on an emergency basis will be briefed of the hazards by the FM/SSO. All activities will stop in emergencies. Personnel exiting the work area because of an emergency will gather in a safe area for a head count. The FM/SSO, in emergencies, will ensure that all people who entered the work area have exited.

4.3 Communication

Cellular telephones will be used as the primary means of communication between the field team(s), Hecla, and offsite ERG personnel. Two-way radios may also be used at the Site to maintain contact between all onsite personnel. Effective communication is critical and will be maintained at all times.

Cell phone use while driving is prohibited when working on all ERG and Hecla projects. This includes driving onsite, as well as driving to and from the Site. Hands-free devices also are prohibited while driving..

4.4 Drugs and Alcohol

- All field personnel may be randomly tested for alcohol and drugs at the request of Hecla. Those refusing to take or failing the alcohol and drugs tests will not be permitted onsite or will be asked to leave the Site.

- The presence or consumption of alcoholic beverages or illicit drugs during the workday, including breaks, is strictly prohibited. Notify your supervisor if you will take prescription or over-the-counter drugs that list drowsiness as a side-effect or indicate that heavy equipment will not be operated while taking the medication.

- Smoking is not allowed outside of designated smoking areas.

4.5 Vehicles

Rules applicable to vehicles are as follows:

- All vehicles entering the Site are subject to search.

- The speed limit is 20 miles per hour. Personnel will drive safely and be aware of other traffic, equipment, fauna and/or foot traffic moving throughout the Site.

4.6 Contamination Control

Rules applicable to contamination control are as follows:

- Remain upwind during intrusive Site activities whenever possible.
- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics will not be applied in the EZ or CRZ.
- Wash hands before eating, drinking, smoking, or using toilet facilities.
- Upon skin contact with materials that may be impacted by COCs, remove contaminated clothing and wash the affected area immediately. Contaminated clothing will be changed. Any skin contact with materials potentially impacted by COCs will be reported to the FCR or HSS immediately. If needed, medical attention will be sought.
- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COCs, such as standing water, mud, or discolored soil. Equipment will be stored on elevated or protected surfaces to reduce the potential for incidental contamination.

4.7 Emergencies

Rules applicable to emergencies are as follows:

- Recognize emergency signals used for evacuation, injury, fire, etc.
- If an emergency situation is encountered in the work area, exit the area (if necessary) and immediately call the local emergency response system (911; if necessary). Be prepared to identify the location, nature of the emergency, number of personnel involved, etc. Note that cell telephones may not reach the local emergency response system. Direct telephone numbers are included in this HASP. It is recommended that emergency telephone numbers be programmed into cellular telephones.

4.8 Records

Rules applicable to records are as follows:

- At least one copy of this HASP will be in a location at the Site that is readily available to personnel, and all field personnel will review the plan prior to starting work.
- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the FM/SSO.

4.9 Operations

Rules applicable to operations are as follows:

- While there are no current confined spaces at the Site, excavations and trenches may be encountered as part of the field work. ERG employees shall comply fully with the OSHA requirements in 29 CFR § 1926 Subpart P.
- ERG personnel and subcontractors will only operate equipment for which they have been trained.
- Obey all warning signs, tags, and barriers. Do not remove any warnings unless otherwise authorized.
- Use, adjust, alter, and repair equipment only if trained and authorized to do so and in accordance with the manufacturer's directions.
- Personnel are to perform only tasks for which they have been properly trained, and will advise their supervisor if they have been assigned a task for which they are not trained.

Exceptions to the buddy system are subject to approval by the ERG PM on a case-by-case basis. Onsite operating personnel, if working alone, will check in with at least one colleague a minimum of twice per day.

4.10 Heat-Related Illnesses

Heat-related illnesses are the most common illnesses associated with heavy outdoor work conducted with direct solar load. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Personnel will be aware of the types and causes of heat-related illnesses, and be able to recognize the signs and symptoms of these illnesses in themselves and their colleagues, especially considering that one's PPE can increase the risk of developing heat-related illnesses

4.10.1 Heat Stress

Heat stress is caused by several interacting factors, including climatic conditions, workload, and biophysical characteristics of the individual.

4.10.2 Heat Rashes

Heat rashes are one of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where clothing is restrictive. Papules give rise to a prickling sensation as sweating increases. Heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

4.10.3 Heat Cramps

Heat cramps are usually caused by hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by an excess or depletion of salt in the body.

Cramps appear to be related to a lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3% sodium chloride), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water will be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate electrolyte replacement liquids can minimize physiological disturbances during recovery.

4.10.4 Heat Exhaustion

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include:

- Pale, cool, moist skin
- Heavy sweating
- Dizziness
- Nausea
- Headache
- Vertigo
- Weakness
- Thirst
- Giddiness

This condition responds readily to prompt treatment. However, heat exhaustion will not be dismissed lightly. The fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that will not be left unattended. In addition, the victim may be injured when he or she faints. Finally, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion will be removed from the hot environment, given fluid replacement, and encouraged to get adequate rest.

4.10.5 Heat Stroke

Heat stroke is the most serious form of heat stress. Heat stroke occurs when the body's system of temperature regulation fails, and its temperature rises to critical levels. This condition is caused by a combination of highly variable factors: its occurrence is difficult to predict.

Heat stroke is a medical emergency. Its primary signs and symptoms are:

- Confusion
- Irrational behavior
- Loss of consciousness
- Convulsions
- Lack of sweating (usually)
- Hot, dry skin
- Abnormally high body temperature (e.g., a rectal temperature of 41degrees Celsius [°C , or 105.8°F])

Death can result from a high body temperature. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, obtain professional medical treatment immediately. The worker will be placed in a shady area and the outer clothing removed. Wet the worker's skin and increase air movement around the worker to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids will be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first-aid treatment.

Regardless of the worker's protestations, no employee suspected of being ill from heat stroke will be sent home or left unattended unless a physician has specifically approved such an order.

4.10.6 Heat Stress Safety Precautions

All employees will be first informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

The FM/SSO will implement heat stress monitoring and work rest cycle when the ambient adjusted temperature exceeds 72°F. Table 4-1 lists broad screening criteria for heat stress exposure.

Table 4-1. Screening Criteria for Heat Stress Exposure

Index	Risk Level	Protective Measures
Less than 91°F	Lower (Caution)	Basic heat safety and planning
91°F to 103°F	Moderate	Implement precautions and heighten awareness
103°F to 115°F	High	Additional precautions to protect workers
Greater than 115°F	Very High to Extreme	Triggers even more aggressive protective measures

Acclimation is a set of physiological adaptations that allows the body to react to heat stress conditions. Full-heat acclimation requires up to 3 weeks of continued physical activity under heat-stress conditions similar to those anticipated for the work. Its loss begins when the activity under those heat-stress conditions is discontinued. A noticeable loss occurs after 4 days. With a recent history of heat stress exposures (e.g., 5 of the last 7 days), a worker can be considered acclimatized.

One or more of the following control measures can be used to help control heat stress:

- Field personnel will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- Onsite drinking water will be kept cool (50 to 60°F).
- A work regimen that will provide adequate rest periods for cooling down will be established, as required.
- Field personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Employees will be instructed to monitor themselves and colleagues for signs of heat stress and to take additional breaks as necessary.
- A shaded rest area will be provided. All breaks will take place in the shaded rest area.
- Employees will not be assigned to other tasks during breaks.
- Employees will remove impermeable garments during rest periods. This includes white Tyvek™, or equivalent.

4.11 Cold Stress-Related Illnesses

Personnel working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body with high surface area-to-volume ratios such as fingers, toes, and ears are the most susceptible. Ambient temperature and the velocity of the wind primarily influence the development of a cold weather injury; e.g., 10 °F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F.

The American Conference of Governmental Industrial Hygienists (ACGIH) has adopted the guidelines developed by the Saskatchewan Labour for working outdoors in cold weather conditions. These guidelines recommend protective clothing and limits on exposure time (Table 4-2). The recommended exposure times are based on the wind chill factor, a scale based on air temperature and wind speed. The work-break schedule applies to any four-hour period with moderate or heavy activity. The warm-up break periods are of 10 minute duration in a warm

location. The schedule assumes that "normal breaks" are taken once every two hours. At the end of a 4-hour period, an extended break (e.g. lunch break) in a warm location is recommended.

Table 4-2. TLVs Work/Warm-up Schedule for Outside Workers based on a Four-Hour Shift

		Wind Speed									
Air Temperature - Sunny Sky		**No Noticeable Wind**		**5 mph**		**10 mph**		**15 mph**		**20 mph**	
°C (approx)	°F (approx)	Max. work Period	No. of Breaks**	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20°to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25°to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
-40° to -42°	-40°to -44°	30 min.	5	Non-emergency work should cease							
≤-43°	≤-45°	Non-emergency work should cease									

Notes:

2008 TLVs and BEIs - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2008 - page 213

"Frostbite" includes local injuries resulting from cold. There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities is further categorized as:

- Frost nip or incipient frostbite: characterized by suddenly blanching or whitening of skin.
- Superficial frostbite: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep Frostbite: tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature, and it can be fatal. Its symptoms are usually exhibited in five stages:

1. Shivering
2. Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of body to less than 95°F
3. Unconsciousness, glassy stare, slow pulse, and slow respiratory rate
4. Freezing of the extremities
5. Death

Trauma sustained in freezing or sub-zero conditions requires special attention, because an injured worker is predisposed to secondary cold injury. Special provisions will be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing first aid treatment.

4.11.1 Safety Precautions for Cold Stress Prevention

The following safety precautions will be followed to prevent cold stress:

- Field personnel will wear dry, protective clothing appropriate for the level of cold and physical activity. In addition, preventive safe work practices, additional training, and warming regimens may be utilized to prevent cold stress.

- For air temperatures of 0°F or less, the hands will be protected by mittens. For exposed skin, continuous exposure will not be permitted when air speed and temperature results in a wind chill temperature of -25°F.

- At air temperatures of 36°F or less, field personnel who become immersed in water or whose clothing becomes wet will be immediately provided with a change of clothing and be treated for hypothermia.

- If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work will be modified or suspended until adequate clothing is made available or until weather conditions improve.

- Field personnel handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F will take special precaution to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

4.11.2 Safe Work Practices

The following safe work practices will be employed to prevent cold stress:

- Avoid direct contact between bare skin and cold surfaces (< 20°F).
- Ensure that metal tool handles and/or equipment controls are covered by thermal insulating material(s).
- Use the buddy system in wind chill temperatures below 10°F. Establish a work rate that prevents heavy sweating. Take rest periods when doing heavy work, and change into dry clothing if needed.
- Provide field personnel with the opportunity to become accustomed to cold weather working conditions and required protective clothing.
- Arrange the work so that sitting or standing still for long periods is minimized.

During the warming regimen (rest period), field personnel will be encouraged to remove outer clothing to permit sweat evaporation or to change into dry work clothing. Dehydration, or loss of body fluids, occurs insidiously in the cold environment and may increase susceptibility to cold injury due to a significant change in blood flow to the extremities. Fluid replacement with warm, sweet drinks and soups is recommended. Limit the intake of coffee because of diuretic and circulatory effects.

4.12 Chemical and Radiological Hazards

The chemical and radiological hazards associated with the field tasks are related to inhalation, ingestion, skin, and direct exposure to Site COCs.

Site COCs include: arsenic, barium, lead, molybdenum, selenium, vanadium, and uranium series radionuclides. Potential routes of entry for Site COCs are as follows:

- Inhalation: airborne dust containing heavy metal radionuclides.
- Ingestion: airborne dust containing heavy metal radionuclide/contaminants and, improper or poor personal hygiene practices.
- Eye and Skin: Direct contact with contaminants. Improper or poor personal hygiene practices. Airborne dust containing heavy metal/radionuclide contaminants. Cuts and abrasions.
- Direct Exposure: Penetrating gamma radiation in air and soil.

4.13 Biological Hazards and Control

Biological hazards may include hanta virus, mosquitoes, plants, snakes, spiders, other stinging insects, and other pests.

4.13.1 Hanta Virus

Hazards – Hantavirus pulmonary syndrome (HPS) is a severe respiratory illness that can be deadly. It is caused by the Sin Nombre virus, one of a family of viruses that is found worldwide. It can be transmitted by infected rodents through urine, droppings, or saliva. There is no known antiviral treatment for HPS, but natural recovery from the virus is possible. Patients with suspected hantavirus are usually admitted to hospital and given oxygen to help them breathe.

Humans can contract the disease when they breathe in aerosolized virus. HPS was first recognized in 1993 and has since been identified throughout the United States. Although rare,

HPS is potentially deadly. There has been one reported case of HPS in New Mexico in 2012; and five since 2011.

Control – Field personnel are advised to avoid areas where rodents nest and feed. This includes the buildings in Area C.

As the virus can be transmitted by rodent saliva, excreta and bites, control of rats and mice in areas frequented by humans is key for disease prevention. General prevention can be accomplished by disposing of rodent nests, sealing any cracks and holes in homes where mice or rats could get in, laying down poisons or using natural predators such as cats in the home.

4.13.2 Mosquitoes

Hazards – Personnel may be exposed to mosquitoes during work activities.

West Nile Virus - Typical exposure to mosquitoes does not present a significant hazard. However, if West Nile virus is prevalent in the area exposure to this virus is increased. West Nile virus results in flu-like symptoms and can be serious if not treated or in immune compromised individuals.

Control – To minimize the threat of mosquito bites all personnel working outside will be aware of the potential for encountering mosquitoes and implement the basic precautions listed below:

- Prevent accumulation of standing water at the Site.
- Apply an insect repellent that contains DEET to exposed skin.
- Wear light colored clothes.
- Do not touch any dead birds or animals that you encounter.

4.13.3 Snakes

Hazards – The possibility of encountering snakes exists, specifically for personnel working in cluttered, wooded, or vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include:

- Neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties.
- Cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs.
- Defects in coagulation.
- Effects from local release of substances by enzymatic actions.

Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control – To avoid snakes, actions that may result in encounters, such as turning over logs. To lower the risk of being bitten:

- Leave snakes alone. Many people are bitten because they try to kill or get a closer look at snakes.
- Be careful where you step, and avoid putting your feet and hands into areas where visibility is restricted. Stay out of tall grass unless wearing thick leather boots. Wear snake chaps or gators for work in grasses, shrub lands, and heavily wooded areas.
- Keep hands and feet out of areas where snakes can be present. Do not pick things up from tall grass, vegetated areas or debris piles without first disturbing the area with a long tool.
- Wear gloves when moving brush and rocks or clearing high grass.
- Use a flashlight at night.
- Be aware of your surroundings.

Bitten victims will be transported to the nearest hospital within 30 minutes. If possible, attempt to identify the snake via size and markings. First aid consists of applying a constriction band

and washing the area around the wound to remove any unabsorbed venom, immobilizing the wounded area and placing it lower than the heart.

First Aid – Call 911 or get the victim immediate medical care. Wash the bite with clean water and soap. Keep the victim calm, immobilize the bite area and keep it lower than the heart. Do not use a tourniquet, apply ice, cut the bite marks or use electrical shock. Do not attempt to catch the snake and take it along to the doctor.

4.13.4 Spiders

Hazards – Personnel may encounter spiders during work activities. Two spiders of concern are the black widow and the brown recluse. Both prefer dark sheltered areas such as basements; equipment sheds and enclosures, around woodpiles, and other scattered debris.

The black widow is shiny, black, approximately 1-inch long, and found throughout the United States. There is a distinctive red hourglass marking on the underside of the black widow's body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms.

The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the Southern United States. The brown recluse has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful. The bite site ulcerates and takes many weeks to heal completely.

Control – To minimize the threat of spider bites, all personnel walking through vegetated areas will be aware of the potential for encountering these arachnids. Personnel will avoid actions that may result in encounters, such as turning over logs and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. Bite victims will be transported to the nearest hospital as soon as possible.

First aid – Apply ice packs and wash the area around the wound to remove any unabsorbed venom.

4.13.5 Other Stinging Insects

Hazards – Thousands of other insects; e.g., bees, wasps, hornets, fire ants, scorpions, centipedes, beetles, and flies, can sting and produce an allergic or toxic reactions of varying degrees. Some common stinging insects are described below.

- Bees usually sting once, leave their stingers, and die. Africanized honeybees; i.e., "killer bees" are more aggressive than common honeybees and often attack in numbers.
- Wasps, including hornets and yellow jackets, can sting repeatedly. Yellow jackets cause the greatest number of allergic reactions.
- Fire ants can attach to skin by biting with their jaws and, pivoting their heads, sting from its abdomen in a circular pattern at multiple sites.
- The kissing bug (Triatoma) will bite humans to obtain blood, often at night. A typical reaction is generally an intensely itchy, red-raised area that is more severe than a typical insect bite. The kissing bug has a large body, measuring 0.5 to 1-in. It has a cone-shaped head and its abdomen is dark brown, with yellow or red markings.
- Scorpions do not bite: they sting with their barbed tails. There are about 20 species of scorpions in New Mexico and toxicity varies with the species. Stings from most scorpions are not likely to be dangerous. That of the Bark Scorpion can be lethal, and its range may encompass the Site. Most people compare a scorpion sting to a bee sting as they both cause a burning pain. Some people also have some swelling. Unless symptoms of an allergic reaction appear, there is little to be concerned about.

Bites and stings are serious if signs of a skin infection, or toxic skin or sudden, severe allergic (anaphylaxis) reaction occur.

In anaphylactic shock, the most severe form of anaphylaxis, blood pressure drops severely; water rapidly leaves the blood stream, causing severe swelling; and bronchial tissues swell dramatically. This causes the person to choke and collapse. Anaphylactic shock is fatal if not treated immediately.

Control – To minimize the risk of insect bites, long-sleeves and full-length pants will be worn if possible. All personnel working in vegetated areas and/or around debris piles and monitor wells will be aware of the potential for encountering stinging insects. Personnel will avoid actions that may result in encounters, such as turning over logs and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures.

Anaphylaxis usually occurs within minutes of exposure to the allergen and almost always within two hours. The most severe cases may be fatal just 10 minutes after exposure. If administered in time, an injection of epinephrine (adrenaline) may reverse the condition by quickly constricting blood vessels, increasing the heart rate, stopping the swelling around the face and throat, and relaxing smooth muscles in the lungs. Because anaphylaxis can progress so quickly, the first signs of reaction will be taken seriously.

Call for emergency help immediately, at the first signs of anaphylaxis.

It is recommended that all field personnel with known allergies to insects, such as allergies to bees, inform colleagues of their condition and carry the appropriate medication with them into the field.

First aid – Wash area around the wound to remove any unabsorbed venom and applying ice packs to minimize swelling.

4.14 Noise

Exposure to noise louder than the appropriate action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increase with the intensity and duration of exposure to noise. In addition, noise can impair voice communication, thereby increasing the risk of accidents on Site.

The noise level is approaching or has exceeded 85 decibels (A-weighted [dBA]) when it is difficult to hear a co-worker at a nominal distance for normal conversation. All personnel will wear hearing protection, with a noise reduction rating (NRR) of at least 20, when noise levels exceed 85 dBA. Field personnel who may be exposed to noise will also receive baseline and annual audiograms, and training as to the causes and prevention of hearing loss.

Whenever possible, equipment that does not generate excessive noise levels will be selected. If using noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

4.15 Spill Control

All personnel will take every precaution to minimize the potential for spills during Site operations. All field personnel shall immediately report any discharge, no matter how small, to the FM/SSO.

Spill control equipment and materials will be located on the Site at locations that present the potential for discharge. All absorbent materials used for the cleanup of spills will be containerized and labeled appropriately. In response to a spill, the FM/SSO will follow the provisions in Section 10.0, Emergency Procedures, to contain and control released materials and to prevent their spread to offsite areas.

4.16 Sanitation

Site sanitation will be maintained according to appropriate federal, state, and local requirements and the guidance provided below.

4.16.1 Break Areas

Breaks will be taken in the SZ, away from the active work area after field personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in any area other than the SZ.

4.16.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided for workers. Potable water will be kept away from hazardous materials or media, and contaminated clothing or equipment.
- Portable containers used to dispense drinking water will be capable of being tightly closed and equipped with a tap dispenser. Water will not be consumed directly from the container (drinking from the tap is prohibited) nor may it be removed from the container by dipping.
- Containers used for drinking water will be clearly marked and shall not be used for any other purpose.

4.16.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels will be provided to workers.

4.16.4 Lavatory

One portable lavatory will be provided to field personnel.

4.17 Emergency Equipment

Adequate emergency equipment for the field tasks, as required by applicable sections of 29 CFR §1910 and §1926, will be onsite at the start of project activities. Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

- Fire extinguishers of adequate size, class, number, and location as required by applicable sections of 29 CFR §1910 and §1926.
- Industrial first aid kits of adequate size for the number of field personnel.

4.18 Overhead and Underground Utilities

Field personnel will be made aware of overhead and underground utilities, in accordance with the methods described in the following sections.

4.18.1 Overhead Utilities

Field personnel will maintain a minimum clearance of 10 feet (ft) from overhead power lines rated up to 50 kilovolts (kV).

Field personnel will maintain a minimum clearance of 10 ft plus 0.4 inch for each kV exceeding 50 kV, or twice the length of the line insulator, but never less than 10 feet.

4.18.2 Underground Utilities

29 CFR §1926.651(b)(1) requires that the estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines or any other underground installations that reasonably may be expected to be encountered during excavation work, be determined prior to opening an excavation (and advancing a boring by implication).

The FM/SSO will contact New Mexico One Call System at 811 or 800-321-ALERT or equivalent local locators, at least two working days prior to the start of subsurface sampling activities, for assistance with marking the locations of underground utilities such as natural gas, electrical, telephone, and cable.

If underground power lines are identified, field personnel will adhere to the advised clearance distances for *overhead* power lines listed in Section 4.18.1.

4.19 Lockout/Tagout Procedures

Only fully-qualified, trained personnel will perform maintenance procedures. Field personnel will follow lockout/tagout procedures per OSHA 29 CFR §1910.147, before maintenance begins. An equipment-specific control procedure will be developed for each piece of equipment that will require maintenance or repair.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy- or material-isolating device such that the equipment cannot be operated until the lock is removed. If a device cannot be locked out, a tagout system will be used. Tagout is the placement of a warning tag on an energy- or material-isolating device indicating that the equipment controls may not be operated until the tag is removed by the worker who attached the tag.

4.20 Lifting Safety

Using proper lifting techniques may prevent back strain or injury. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted.
- If alone, use a mechanical lifting device or help from colleagues if the object cannot be lifted safely.
- Keep hands and objects free of substances that could prevent a firm grip.
- Use gloves will be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces prior to lifting.
- Fingers will be kept away from pinch or crush points.
- Feet will be placed far enough apart for balance, on solid ground.
- Clear the intended pathway.
- The load will be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker will not carry a load that he or she cannot see around or over.
- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.21 Fall Protection

A fall protection system is required for all personnel exposed to fall hazards greater than 6 feet. Fall protection systems will comply with the guidelines established in 29 CFR §1926 Subpart M. All personnel exposed to fall hazards will be trained by a competent person in the following areas:

- Nature of fall hazards in the work area.
- Correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used, and the employees' roles and responsibilities associated with the systems.

- Use and operation of the fall protection systems to be used.
- Correct procedures for handling and storing materials and equipment, and for erecting overhead protection.
- Fall protection standards in 29 CFR §1926 Subpart M.

Written certification of fall protection training for personnel exposed to fall hazards will be maintained by each contractor and will be made available to the field manager upon request.

4.22 Ladder Safety

Ladder use will be in compliance with 29 CFR §1910.25 and §1910.26. A specific JSA for ladder use will be available to field personnel.

5.0 CONFINED SPACE ENTRIES

There will be no confined space entries in the site assessment. Thus, confined space entry procedures are not applicable to the field tasks prescribed in the SAP.

6.0 PERSONAL PROTECTIVE EQUIPMENT

Based on the nature of contamination present at the Johnny M Mine and the invasiveness of the field task, field personnel will be required to wear PPE. Note that additional PPE requirements are in effect in EZs.

6.1 Applicable Levels of Protection

The levels of protection prescribed for the field tasks are Level D and Modified Level D.

6.1.1 Level D Protection

The minimum level of protection that will be required of field personnel onsite is Level D, which will be worn when no dermal hazard exists. The following equipment will be used:

- Shirt and pants, with additional work clothing as prescribed by weather.
- Work gloves, if hand hazards are present.
- Steel toe and shanked work boots, meeting American National Standards Institute
- (ANSI) Z41 Standards.
- Safety goggles/glasses, meeting ANSI Z87 Standards.
- Hard hat, meeting ANSI Z89 Standards, if falling object hazards are present.
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with an EPA Noise Reduction Rating of at least 20 dBA will be used).

6.1.2 Modified Level D Protection

Modified Level D will be used during intrusive field tasks, because there is potential for skin contact with contaminated materials. In addition to the basic Level D requirements, Modified Level D consists of:

- Work gloves worn over nitrile surgical gloves.
- Rubber/Latex/PVC overboots when contact with COC-impacted media is anticipated.
- Face shield in addition to safety glasses or goggles when projectile or splash hazards exist
- Tyvek®, KleenGuard® coveralls, or equivalent.

6.2 Using PPE

The procedures presented in this section are mandatory for the use of Modified Level D PPE. All personnel entering the EZ will put on the required PPE in accordance with the requirements of this HASP. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of COCs.

6.2.1 Donning Procedure

The procedure for donning Modified Level D PPE is:

- Remove bulky outerwear.
- Remove street clothes and store in clean location.
- Put on work clothes or coveralls.
- Put on the required chemical-protective coveralls.
- Put on the required chemical-protective boots or boot covers.
- Tape the legs of the coveralls to the boots with duct tape.
- Put on the required chemical-protective gloves.
- Tape the wrists of the protective coveralls to the gloves.

- Put hood overhead, if applicable.
- Don remaining PPE, such as safety glasses or goggles and hard hat.

6.2.2 Doffing Procedure

The procedure for doffing Modified Level D PPE is:

- Upon entering the CRZ, rinse or wipe contaminated materials from the boots or remove contaminated boot covers.
- Clean reusable protective equipment.
- Remove protective garments, equipment, and respirator (Level C). All disposable clothing will be placed in plastic bags, which are labeled with contaminated waste labels.
- Wash hands, face, and neck (or shower if necessary).
- Proceed to clean area and dress in clean clothing.

All disposable equipment, garments, and PPE will be bagged in plastic bags, labeled for disposal. See Section 8.0, Decontamination, for detailed information on decontamination stations.

7.0 MONITORING REQUIREMENTS

Monitoring is a critical part of the onsite safety program for hazardous waste field activities. This section discusses the monitoring requirements and action levels for upgrading PPE or stopping work.

7.1 Noise Monitoring

When personnel are within 25 feet of heavy equipment, the noise levels are likely to be at or above 85 dBA. For this reason, anyone within 25 feet of such equipment is required to wear hearing protection. Additional noise measurements are not required.

7.2 Dust Monitoring

Dust at the Johnny M Mine may contain both radionuclides and heavy metals. Total dust will be monitored as a real-time surrogate to estimate potential exposure based on soil concentrations observed, using a Thermo MIE Personal Data Ram, or equivalent.

The observed total dust concentrations will be used to evaluate worker breathing zone exposure. Representative measurements, in frequency and duration, will be collected at the discretion of the FM/SSO. Table 7-1 lists the applicable actions to respective measurements:

Table 7-1. Dust action levels

Dust Concentration (Instantaneous, mg/m^3)	Action
background to 0.5 mg/m^3	Continue work
> 0.5 mg/m^3 to 15.0 mg/m^3	Employ dust suppression techniques, change task, take advantage of wind direction, or Stop Work.
>15.0 mg/m^3	Stop work

Notes:
mg/m^3 = milligrams per cubic meter

7.3 Occupational Radiological Monitoring

Occupational radiological monitoring will be conducted as follows:

- Total alpha and beta/gamma measurements will be conducted on the surfaces of representative materials, equipment, and vehicles as they are brought onsite (entry surveys). The total alpha and beta gamma measurements will be taken using a Ludlum Model 43-5/2241 zinc sulfide alpha scintillation detector and Ludlum 44-9/12 Geiger-Meüller pancake probe, or their equivalents.

- The FM/SSO, or his designee, will take total alpha surface measurements on all materials, equipment, and vehicles to be released from the Site for unrestricted use. Selection of the number of measurements will be at the discretion of the FM/SSO. Measurements will be taken on representative surfaces, using a Ludlum Model 43-5/2241, or equivalent.

- The FM/SSO, or his designee, also will collect wipe samples of removable alpha/beta contamination on all materials, equipment, and vehicles. The wipe samples will be measured using Ludlum Model 43-10-1/2929 alpha/beta tray counters, or equivalent.

The action levels (and free release limits) for material and equipment are 5,000 total alpha (α) disintegrations per minute (dpm) per 100 square centimeters (cm^2) alpha averaged over 1 square meter (m^2) and a maximum of 15,000 dpm/100 cm^2. The removal (non-fixed contamination) action level is 1,000 α dpm/100 cm^2.

Measurements exceeding the action levels will be investigated and attenuated, if possible, by way of decontamination.

Personnel will be frisked for alpha contamination upon each exit of a particular EZ. Measurements will be taken on hands and feet, using a Ludlum Model 43-5/2241, or equivalent.

The action level for personnel scans is detectable activity above background. Measurements exceeding the action level will be investigated and attenuated, if possible, by way of decontamination.

Personal dosimeters will not be provided to field personnel. The maximum dose from external sources is anticipated to be less than 1 millirem (mrem) per 3 month work period.

OSHA requires that workers be limited to less than 25 percent of derived air concentration (DAC), averaged over a 40 hour week. It is anticipated that exposure to airborne radioactive particulates will not be significant during invasive activities, largely due to their brevity. Field personnel are expected to be exposed to negligible levels of airborne radioactive particulates during the non-invasive activities; i.e., walking, downhole gamma logging, and taking HPIC measurements.

7.4 Monitoring Equipment Maintenance and Calibration

Monitoring equipment will be maintained and calibrated in accordance with manufacturer's procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures. When applicable, only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

Radiological instruments will be function checked daily, before and after use, noting the reading(s) and any adjustments that are necessary.

If an instrument is found to be inoperable or suspected of giving erroneous readings, the FM/SSO will remove the instrument from service and obtain a replacement unit. If the instrument is essential for safe operation during a specific activity, that activity will cease until an appropriate replacement is obtained.

8.0 DECONTAMINATION

Decontamination procedures are prescribed for personnel, equipment, and PPE in the following sections.

8.1 Personnel Decontamination

Based on the results of radiological scanning, field personnel may be required to be decontaminated. If so, personnel will be decontaminated in the CRZ, using water and/or paper towels.

8.2 Equipment Decontamination

Equipment such as monitoring instruments, tools, and other items that have been handled with gloved hands shall be decontaminated prior to being handled with ungloved hands. Visible contamination will be removed by wiping the equipment with "wet wipes" or other comparable product. Tools and instruments will be screened using a Ludlum Model 43-5/12 alpha detection system, or equivalent. If detectable counts are observed during scanning, decontamination will be repeated. More aggressive methods; e.g., scrubbing with soap and water, abrading, grinding, and/or washing in an acid, may be required for some items.

All vehicles that have entered the EZ will be scanned for radiological contamination and decontaminated, if applicable, at the decontamination pad prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required.

Tools, instrument, and equipment will be free-released if surface measurements are below the limits provided in Section 7.3.

8.3 PPE Decontamination

Single-use, external protective clothing will be used for work within the EZ or CRZ, if possible. This protective clothing will be disposed of in properly labeled containers. Reusable protective clothing, if contaminated, will be rinsed with detergent and water. The rinseate will be collected for disposal.

8.4 Emergency Decontamination

If an injured employee is contaminated, emergency decontamination may be required prior to transportation to a treatment facility. Note that the health of the injured employee is paramount. Decontamination is not necessarily required prior to medical treatment. Steps for emergency decontamination are:

- Remove the outer protective layer of clothing (if employee has a suspected neck/back injury, carefully cut the clothing off so as to not cause further injury.

- Wipe off any remaining gross contamination with clean clothes/towels.

If possible, an ERG employee will accompany the injured person to the hospital to provide information to the examining/treating medical professional. If possible, the accompanying ERG employee will bring the Material Safety Data Sheets (MSDSs) for the COCs involved with Site work. The accompanying employee will be prepared to provide information regarding Site conditions, potential exposures, and a description of the incident causing the injury or exposure.

9.0 TRAINING AND MEDICAL SURVEILLANCE

The following sections describe the requirements for training and medical surveillance.

9.1 Training

Training is subdivided into general and site-specific requirements, safety meetings, and First Aid/Cardiopulmonary Resuscitation (CPR).

9.1.1 General

Field personnel who work in areas where they may be exposed to Site contaminants will be trained as required by 29 CFR §1910.120 (HAZWOPER). Field employees also will have received a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their initial training more than 12 months prior to starting the project will have completed an 8-hour refresher course within the past 12 months. The FM/SSO will have completed an additional 8 hours of supervisory training.

9.1.2 Site-Specific Training

Site-specific training will be accomplished by way of reading this HASP or a thorough briefing by the PM/HSO or FM/SSO on the contents of this HASP. The review will include a discussion of the chemical, physical, and biological hazards; protective equipment and safety procedures; and emergency procedures.

9.1.3 Safety Meetings

Daily safety meetings will be held as required to cover the work to be accomplished, hazards anticipated, PPE and procedures required to minimize Site hazards, and emergency procedures. The FM/SSO, or his designee, will hold these meetings at the start of the day and, if applicable, after lunch. A safety meeting also will be held prior to new tasks, and repeated if new hazards are encountered.

9.1.4 First Aid and CPR

If practicable, at least one employee current in First Aid/CPR will be assigned to the work crew and will be onsite during operations. These individuals will also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

9.2 Medical Surveillance

All personnel who are potentially exposed to Site contaminants will participate in a medical surveillance program as defined by 29 CFR §1910.120 (f). The medical surveillance program is comprised of medical examinations and restrictions.

9.2.1 Entry, Periodic and Exit Medical Examinations

All potentially exposed personnel will complete a comprehensive medical examination prior to employment, periodically thereafter, and upon termination, as defined by 29 CFR §1910-120(f).

The frequency of periodic examinations is annual, for employees potentially exposed for more than 30 days per year. The frequency of periodic examinations is 24 months, for employees potentially exposed for less than 30 days per year.

These medical examinations typically include the following elements:

- Medical and occupational history questionnaire.
- Physical examination.
- Complete blood count, with differential.
- Liver enzyme profile.
- Chest X-ray, at a frequency determined by the physician.
- Pulmonary function test.
- Audiogram.

- Electrocardiogram for persons older than 45 years, or if indicated during the physical examination.
- Drug and alcohol screening, as required by job assignment.
- Visual acuity.
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

The examining physician will provide the employee with a letter summarizing his findings and recommendations, confirming the worker's fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all field work.

Subcontractors will certify that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations will meet the requirements of 29 CFR §1910.120 and 29 CFR §1910.134.

9.2.3 Discretionary Medical Examinations

Personnel also may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials.
- At the discretion of the PM/HSO, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials.

9.2.4 Medical Restrictions

When the examining physician identifies a need to restrict work activity, the employee's supervisor will communicate the restriction to the employee and the HSO. The terms of the restriction will be discussed with the employee and his/her supervisor.

10.0 EMERGECNY PROCEDURES

This section describes procedures used in emergencies, contaminant releases, first aid cases, and information regarding emergency assistance.

10.1 General

Prior to the start of field work, the Site will be evaluated for the potential for fire, contaminant release, or other catastrophic event. Unusual conditions or events, activities, chemicals, and conditions will be reported to the HSO within 24 hours.

The HSO, or his designee, will establish evacuation routes and assembly areas for the Site. All personnel entering the Site will be informed of this route and the assembly area.

10.2 Emergency Response

If an incident occurs, the FM/SSO will:

- Evaluate the incident and assess the need for assistance and/or evacuation.
- Call for outside assistance as needed.
- Promptly notify the PM/HSO and client representative of the incident.
- Take appropriate measures to stabilize the incident scene.

10.2.1 Fire

In the case of a fire onsite, the FM/SSO will assess the situation and initially direct firefighting activities. The FM/SSO will notify the client representative and PM immediately. Site personnel will attempt to extinguish the fire with available extinguishers, if safe to do so. In the fire is unsafe to extinguish, the FM/SSO will call 911.

10.3 Medical Emergency

Any one of the field personnel has the authority to call 911 immediately, on behalf of an injured co-worker.

All employee injuries will be promptly reported to the FM/SSO. In emergencies, the worker will be transported by appropriate means to the Cibola General Hospital.

10.4 First Aid – General

All personnel will report injuries or illnesses to their immediate supervisor and FM/ SSO. Trained personnel will administer first aid. The FM/SSO will document injuries and illnesses requiring medical treatment. The FM/SSO and PM will conduct an incident investigation as soon as emergency conditions no longer exist and first aid and/or medical treatment have been obtained. Incident investigations will be completed and submitted to the PM within 24 hours after the incident.

First aid kits will be kept in all ERG vehicles used onsite. In a non-emergency, if treatment beyond first aid is required, the injured person(s) will be transported to the Cibola General Hospital, or another appropriate medical facility. If the injured person is not ambulatory, or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics will be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

10.5 Emergency Assistance Information

This section contains emergency telephone numbers for the closest hospital capable of providing emergency service for field personnel, and a map showing the location of and direction to the nearest hospital. Additionally, internal contact numbers are provided.

10.5.1 Emergency Services

In emergencies, any person onsite will call 911. ERG will take the lead role in administering first aid and directing emergency personnel to the injured worker.

The address of the nearest hospital is:

Emergency Services
Cibola General Hospital
1016 East Roosevelt Avenue
Grants, NM 87020
Phone: (505) 287-4446

The recommended route from the Site to Cibola General Hospital is shown on Figure 1-1 and described as follows.

Enter onto State Highway 605 West and drive 21 miles. Turn left onto State Highway 122 and travel east for 2.6 miles. Continue onto W Santa Fe Ave for 1.4 miles and turn left onto 1st St. Drive 0.9 miles and make a slight right turn onto W Roosevelt Ave. The destination is on the left

Total Estimated Time: 30 minutes
Total Estimated Distance: 47.97 miles

A copy of the hospital route map will be kept in all Site support vehicles. All field personnel will become familiar with the route and travel time required.

10.5.2 Other Emergency Contact Telephone Numbers

Emergency Contacts

Emergency/Contingency Contact Telephone List	
Local Emergency Contacts	**Phone Number**
Fire: Grants Fire Department	911 (Emergency) 505.876.2245 (Non-Emergency)
Local Police: Grants-Police Department	911 (Emergency) 505.287.2983 (Non-Emergency)
Hospital: Cibola General Hospital 1016 East Roosevelt Avenue Grants, NM 87020	505.287.4446
Emergency Contacts	
ERG Field Manager: Neil Wrubel	Phone: 505.298.4224 Cell: 505.803.7103
ERG Project Manager: Mike Schierman	Phone:505.298.4224 Cell: 505.301.5312

10.6 Non-Emergency, Non-Life Threatening Work Related Injury or Illness

For minor illnesses or injuries that may be work-related and are not life threatening or emergencies, employees will take the following steps before seeking medical treatment at a medical treatment facility:

- Workers are encouraged to contact WorkCare as soon as possible, at 1-800-455-6155.
- WorkCare will discuss the medical issues with you and provide appropriate medical guidance.
- Workers are then asked to speak with their supervisor and keep him/her informed on actions being taken.
- Workers are asked to seek medical attention immediately if an injury or illness is life-threatening or an emergency.
- Workers are asked to notify their supervisor of the event, as soon as possible.

11.0 HAZARD COMMUNICATION

OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of such information as:

- Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers;
- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately.

Employers are required to train workers by December 1, 2013 on recent changes to elements in labels and the format of MSDSs.

Chemicals and materials brought to the Site that are subject to the OSHA HCS will be 1) labeled properly with hazard classifications and 2) accompanied by MSDSs that are available for review by all field personnel.

12.0 REFERENCES

EPA, 1992. *Standard Operating Safety Guides,* 9285.1-03/PB92–963414.

ERG, 2012. *Draft Site Assessment Plan for the Johnny M Mine and Adjacent Property,* May.